THURSDAY, JULY 24, 1879

ROMAN ANTIQUITIES

Roman Antiquities at Lydney Park, Gloucestershire. Being a Posthumous Work of the Rev. William Hiley Bathurst, M.A., with Notes by C. W. King, M.A., Fellow of Trinity College, Cambridge. Pp. vii., 127; Plates xxxi., quarto. (London: Longmans, Green, and Co., 1879.)

LYDNEY PARK appears to be the property of the Bathursts, having been purchased by Mr. Benjamin Bathurst in 1723, so the remains found there have been mostly disinterred under the superintendence of different members of the family in successive generations, and then carefully drawn and described by them. "When the Roman constructions in Lydney Park," the editor tells us in the preface, "were first regularly explored, at the beginning of this century, the Right Hon. C. Bathurst, after taking accurate plans and drawings of the several rooms as they successively came to light, composed a detailed description, in two parts, of the Villa and the Temple." The whole appears to have been found too long and too discursive for publication; so the late Mr. Bathurst, whose name appears on the title-page, "prepared, with great care not to omit any really important particulars, a summary of both these manuscript memoirs; and this forms the text of the volume now printed." But in addition to the papers left by the elder Bathurst, "his daughter, Miss Charlotte Bathurst, had drawn up a descriptive catalogue of coins, selected for their special interest or beauty of condition from amongst the immense quantity found in the course of the excavations." This list Mr. King found "upon examination to exhibit such accurate knowledge of numismatics, coupled with such intelligence in the selection of the pieces," that he has published it without any important alteration; and so far as one can learn from the present volume the Bathursts deserve great credit for this enlightened appreciation of the archæological treasure which had fallen to their lot. But the reader must not be left to conclude that the whole of it has passed through their hands, for Mr. Bathurst says that "Major Rooke, who published some account of this camp in the 'Archæologia,' v. 207, in 1777, was frequently at Lydney, and was allowed to dig wherever he was inclined. Others also were in the habit of searching for coins and other antiquities, and taking them away." Then there has been the usual quarrying for building-stone with the usual result of materially damaging the old pavements, which seem to have still further suffered from a search for iron ore in the limestone of which the hill is composed, on which the camp stood.

So much by way of introduction: I shall not attempt to describe the coins, the articles of bronze or iron, and the tesselated pavements, but confine my remarks to the antiquities relating to the god Nodens, which Mr. King rightly considers to exceed largely in curiosity and value anything of the kind yet discovered in this country. The inscriptions on the votive tablets have long been known, and will be found in the seventh volume of the "Corpus Inscriptionum Latinarum," edited by Hübner for the Berlin Academy. One of them consists of a sheet of lead "carelessly scratched with a graver," and reads in plate xx:—

DEVO
NODENTI SILVLANVS
ANILVM PERDEDIT
DEMEDIAM PARTEM
DONAVIT NODENTI
INTER QVIBVS NOMEN
SENICIANI NOLLIS
PETMITTAS (*sic*) SANITA
TEM DONEC PERFERA[T]
VSQVE TEMPLVM NO
DENTIS.

It is thus rendered by Mr. King: "To the god Nodens. Silvianus has lost a Ring: he has made offering (*vowed*) half (*its value*) to Nodens. Amongst all who bear the name of Senecianus, refuse thou to grant health to exist, until he bring back the Ring to the Temple of Nodens." But why *Silulanus* should be made into *Silvianus* I fail to see; for my part I should regard the former as re-echoing the national name of the Silurians; but that is, of course, another matter.

Another of the tablets is of bronze with *pointillé* letters surmounted with the figure of an animal which the editor pronounces to be a wolf and not a dog as had hitherto been supposed; he believes the vow to have been made on the occasion of an escape from a wolf—it reads thus:—

PECTILLVS
VOTVM QVOD
PROMISSIT
DEO NVDENTE
M. DEDIT.

The chief question which this suggests is what the *M* stands for; Hübner suggests *Marti*, *Maximo*, and *Meritò*, but prefers the two former and gives the first place to *Marti*; but Mr. King does not take this last into account, while he decides in favour of Maximo as against Meritò, and on the whole this seems satisfactory and suits the remaining bronze tablet, which reads in letters, formed in the same *pointillé* fashion as those of the previous one, as follows:—

D. M. NODONTI
FL. BLANDINVS
ARMATVRA
V. S. L. M.

Besides these tablets there have been found at Lydney a number of detached letters cut out of a thin plate o bronze for affixing to a surface by means of small nails in order to make an inscription, as in the case of the *Maison Carrée* at Nismes, excepting that the Lydney ones were, as Mr. King thinks, to be fixed to a wooden surface, probably that of the coffer; but what is interesting is that when sorted the letters make NODENTI SACRVM, excepting that one-half of the letter *s* has not yet been found.

But the inscription which presents most difficulty has still to be mentioned: it is worked into the tesselated pavement of the temple and consists of two long lines. "With the aid of the accurate drawing made at the time of its discovery," and by comparing "the imperfect characters with those well preserved," the editor thinks he has improved on previous attempts to decipher the dedication, which he reads as follows, with the abbreviations extended:—*Deo Maximo* IT*erum* FLAVIVS

SENILIS PR*aeses* REL*igionis* EX STIPIBVS POSSVIT O*pitu*LANTE VICTORINO INTER*prete* L*a*TINE. Accordingly he translates:—"To the greatest God, for the second time, Flavius Senilis, Head of the Religion, has erected this, from voluntary contributions, the Director of the works being Victorinus, interpreter for the Latin tongue." On the whole the profession of Victorinus is open to some doubt, as several of the letters following INTER are very far gone; however Mr. King strongly maintains that the hitherto accepted reading of INTERAMNATE is impossible. Perhaps a difference of opinion may still be allowed to exist as to the profession of Flavius Senilis also; but it is tolerably evident both from this inscription and the others already mentioned which were found in the same building, that it was the temple of the god Nodens. That the *D. M.* with which the dedication begins stand for *Deo Maximo* is in Mr. King's opinion put beyond doubt by the heading of the votive tablet of Flavius Blandinus. Such a prelude he thinks is designed to mark the god's supremacy, while his name is superfluous in his own temple, every visitor being supposed to recognise him as "the supreme deity of Siluria." He then goes on to produce reasons for supposing the rebuilding of the temple to have taken place in the time of Agricola and in consequence of the encouragement he gave the Britons to engage in works of civilisation. But the fact of the re-erection taking place under the eyes of the Romans will prepare the reader to find this Silurian deity represented in the classical fashion. Mr. King thinks that he was meant for a sea or river god, and that fact is, in his opinion, "placed beyond doubt by the design of the pavement, *dedicated to him*, be it observed, that decorates the floor of the temple." The description he gives of them is as follows (p. 39):—"The centre is formed by two sea-serpents, represented in the usual form given by the Greek painters to the dreaded κῆτος, as it is seen in the Pompeian wall-painting of Perseus and Andromeda. This sea-monster closely resembles the ichthyosaurus of geologists, with its elongated neck and pectoral paddles, or 'flippers,' which are coloured bright red in our mosaic to augment the savageness of its aspect. The field is occupied with figures of fish, evidently salmon, the chief glory of the Severn." We have not yet done with the pavement, for in the part occupied by the dedicatory inscription, but not quite in the centre, seemingly not to cut up the names, as Mr. King thinks, there is what he describes as "a circular opening, nine inches in diameter, surrounded by a broad red band, again inclosed in two others of blue. That some high mystery was involved in the setting of this unsightly object in so conspicuous a position cannot admit of any doubt." He comes to the conclusion that this funnel was meant to receive libations poured to the god, and that they were drunk up by the dry soil beneath. He further compares this opening in the pavement "to the well of salt water, that famous memorial of the former presence of Poseidon, in the Acropolis of Athens."

In addition to the foregoing inscriptions there has been found there what is described by the editor as "a bronze plaque, clearly intended for personal decoration; the most obvious purpose to which it can"—he thinks—"be assigned, being that of the frontlet of the head-dress worn either by the idol itself or by the officiating priest, after the manner of the large ornamented disks of thin gold so frequently turned up in Ireland." The following is his description of this ornament:—

"In the centre rises a youthful deity . . . . he is crowned with rays like Phœbus (or more probably 'his bonnet sedge,' like Camus), carries a sceptre, and is borne over the waters in a car drawn by four sea-horses, like the Roman Neptune. On each side floats in the air a winged Genius, clearly typifying the Winds, one holding forth in his right the leaf-shaped fan commonly seen in the hands of Roman ladies; the other Zephyr similarly waves a handkerchief; both grasp in the left hand the end of the shawl or *chlamys*, thrown loosely over each arm. Rude as is the engraving, there is a lightness and freedom in the drawing of these figures much to be admired, and expressing with great truth the airy nature of the beings it attempts to embody. Each end of the composition is filled up with a reclining Triton; the one brandishing two paddles of the very shape still employed by those that navigate the primitive British bark, the coracle; the other, an anchor, and his proper attribute, the shell-trumpet, the *cava buccina*, assigned to him by Ovid."

There remains another piece of ornamentation, which Mr. King regards as a fragment of the foregoing; but I must give his own words:—

"On the smaller fragment, evidently part of the same decoration, Triton is yet more distinctly represented; he is here winding a blast on his conch to call the winds to do him service, whilst he wields the anchor for sceptre; on the other side sits the votary of Nodens, the Silurian fisherman, enveloped in the hooded frieze mantle worn to this day by his brethren of Naples, and who, by the favour of the god, has just hooked a magnificent salmon."

Mr. King is somewhat unlucky when he comes to touch on questions of Celtic philology, as will be seen from the following extract:—

"Dr. McCaul quotes from a letter from Meyrick to Lysons that 'Deus Nodens seems to be Romanised British, which correctly written in the original language would be Deus Noddyns, the "God of the abyss," or it may be "God the preserver," from the verb *noddi*, to preserve; both words being derived from *nawdd*, which signifies protection.' Prof. Jarrett, a profound Celtic scholar, to whom I applied for a translation of 'Deus Noddyns' without mentioning Meyrick's explanation, at once rendered it as 'God of the deeps,' a sense that every circumstance confirms."

What Meyrick may have said to Lysons on Celtic philology had best be forgotten, and with all respect to a Celtic scholar with whose name I do not happen to be acquainted, it will be at once admitted by all those who know Welsh, that *Noddyns* is gibberish; nay, I might go so far as to say that it could not be made to fit into the vocabulary of any Celtic language past or present. The word which in all probability suggested it to Meyrick was *anoddyn* or *anoddyfn*, "abyss," with which *Nodens*, however, could not, according to any known rules of Welsh phonology, be connected. This wretched bit of philology does not, I am glad to say, vitiate the rest of the editor's reasoning, which seems to me so good that I should like to put him on another tack. In a lecture not yet published, but delivered before the present volume was published, I ventured to equate the name of the god with that of another, which I thought I detected in an Irish proper name: I allude to Mogh Nuadhad (in an older orthography Mog Nuadat), the name of a Munster prince

well known in Irish legend. It means the slave or servant of Nuadha, and belongs to a group of Irish proper names which I take to be of a Non-Aryan origin, and to mark the præ-Celtic race of Ireland. Another of the same kind was Mogh Néid, the slave or servant of Néid; for the Ancient Irish had a god of war called Néid or Nét.

This kind of nomenclature, I need hardly say, is well known on Semitic ground: take, for instance, the biblical *Abdiel*, "servant of God," or the inscriptional *Abdastartus*, "servant of Astarte." On the other hand the Aryans gave the preference to compounds such as the Sanskrit Deva-datta, Greek Θεό-δοτος, or the Welsh *Cad-wal*, Irish *Cath-al*, Old German Hatho-wulf, or the wolf of war. To return to Lydney, the name *Nodens*, genitive *Nodentis* is precisely what would make in Irish, according to the phonological laws of that language, a nominative *Nuadha*, genitive *Nuadhat*, that is on the supposition that the first syllable of the god's name was long, *Nōdens* or *Nūdens*; further, corresponding to an Irish nominative *Nuadha*, the Welsh form should be *Nudd*, with *ū* pronounced nearly like German *ü*, and *dd* like *th* in the English word *this*; and Nudd occurs in Welsh both in prose and verse, namely, in connection with *Edern son of Nudd* and *Gwyn son of Nudd*, where it probably meant a god-ancestor rather than the father; compare Bran son of Llyr, that is, Bran son of the Sea. Even the hesitation in spelling between *Nodens* and *Nudens* fits exactly into Welsh phonology, which makes both the ō and the ū of the language in its early period into ū in its later stages; from the Lydney inscriptions this would seem to have been nearly accomplished in the first century.

It is unfortunate that Welsh literature gives us no information as to the attributes of Nudd; the case is much the same with Nuadha in Irish literature, but it is right to say that the latter makes Nuadha to be a king of the Tuatha Dé Danann, that is to say, king of the most mythical race in Irish legend, and the following passage in O'Curry's Lectures on the Manners and Customs of the Ancient Irish (iii. 156) is to the point, though he gives no reference to the original, which he had in view in it:—"The river Boyne, from the clearness of its waters, was poetically called *Righ Mná Nuadhat*; that is, the wrist or forearm of *Nuadhat's* wife. This lady was one of the *Tuatha Dé Danann*; and the poetical allusion to her arm originated from her keeping it constantly covered with rings or bracelets of gold to bestow upon poets and musicians." I am inclined to think that the term *Righ Mná Nuadhat* had a much deeper meaning, and that it is, in fact, a relic of Irish mythology. For there is good ground for believing that the Boyne was personified and probably worshipped; I conclude this from the meaning of its name, which was in Old Irish *Bóind*, genitive *Bóindeo*, and in Ptolemy's Geography Βουουίνδα, *i.e.*, *Buwinda*, which has been equated and, no doubt, correctly with the Sanskrit adjective *govinda*, which, according to the Petersburg Dictionary, means "acquiring or winning cows or herds," and occurs as an epithet to Bṛhaspati, Kṛshṇa, and Vishnu. In Cormac's Glossary we learn that the Boyne had another name, Bergna or Bregna, which also appears to have been personal. In Britain, the Dee, for example, was undoubtedly regarded as a divine stream, and probably also Ptolemy's Belisama wrongly identified in my Lectures on Welsh Philology with the Dee. If, then, the Boyne was such another river divinity, nothing could be more natural than for the muse of mythology, if I may use the term, to marry her to Nodens, god of the sea, if it is right, as it seems to be, to describe him as such.

Mr. King touches on several minor points of great interest to Celtic philologists, as, for instance, when he says of Senilis, "that his uncommon *cognomen* is probably a translation of his British name, *Hen*, the Old;" but it is hardly necessary to speak here of a translation, as at the date of the dedication *hen* was *sen* in all Celtic languages, and the Welsh change of initial *s* into *h* did not set in for centuries afterwards. With *Senilis* may be compared or contrasted the Senilus of the post-Roman inscription of St. Just in Cornwall, see p. 406 of the Lectures on Welsh Philology, and also the "Grammatica Celtica," p. 769, where an Irish name is mentioned as written *Sinill*, with which may be compared the *Senyllt* of later Welsh: more than one of these forms seem to postulate a Latin Senilius. Hübner has other instances of *Senilis* besides the one from Lydney. Quite distinct from the fortune of initial *s* was that of vowel-flanked *s*, as it has disappeared without a trace both in Welsh and Irish, and that probably at a very early date: possibly before they had differentiated themselves into distinct languages. The Lydney inscriptions seem to me to give strong indirect evidence to the effect that it had in this country disappeared before the first century; for the best explanation of the doubling of the *s* in POSSVIT and PROMISSIT is to suppose the inscriber to have been a Celt, in whose language, as in Welsh and Irish, a soft *s* or single *s* between vowels was unknown; his mistake could be copiously paralleled by the way Welshmen of the present day deal with English *s* and *z*. I suspect also that the Celtic word for god, of the same origin and derivation as the Latin *dīvus* and beginning, as it must have in early Welsh, with the syllable *dēv*, had not a little to do with the spelling DEVO in the tablet of Silulanus.

I cannot end this somewhat lengthy notice without heartily thanking Mr. King and the Bathursts for a volume so full of interest and so well got up.

JOHN RHŶS

THE RIGHTS OF AN ANIMAL

The Rights of an Animal; a New Essay in Ethics. By Edward Byron Nicholson, M.A., Principal Librarian and Superintendent of the London Institution. (London: C. Kegan Paul and Co., 1879.)

THIS is a little book—too little to be satisfactory. Its object is to argue that "*animals have the same abstract rights of life and personal liberty with man.*" The ambiguity which attaches to the word "same" in this opening statement of the "principle" to be proved casts its shadow over all the remaining sixty pages of which the essay consists. That animals have not in all respects *identical* "rights of life and liberty with man" is too obvious a truth for even Mr. Nicholson to combat. He neither objects to the slaughtering of animals for food nor to the working of animals for purposes useful to man. Yet if the rights of animals were, strictly speaking, "the same" as those of man, the former act

would be one of murder, and the latter one of unjustifiable slavery. It is clear, therefore, that for the purpose of lucid statement we ought to be supplied with some definition of the sense in which the author supposes the rights of animals to be comparable with those of man. And it is because this definition is nowhere supplied that we deem the work unsatisfactory. That animals, as sentient creatures, have *some* rights—*i.e.*, that man may not kill or torture them needlessly without incurring *some* moral blame—no one nowadays would undertake to dispute.[1] It therefore seems useless to fill a number of pages with a number of truisms on the theme that animals have some rights in common with man. From the writer of "a new essay in ethics" we expected to find a statement of the principles by which the rights of animals ought to be defined—in what they resemble and in what they differ from the rights of man, and why. But instead of this we find only the statement of a fact which it does not require "a new essay in ethics" to reveal, viz., that the immorality of subjecting animals to needless death or torture cannot be justified on the ground of any such irrelevant or untrue arguments as that animals are irrational, not immortal, or non-sentient. Such being the whole scope of the work, it seems to us to be about a century too late in appearing.

At the present time, when the ethics of vivisection and kindred questions are being so warmly discussed, there is a good opportunity for a competent essayist to write an interesting, if not valuable treatise, on the basis, the nature, and the extent of animal rights, as well as the ways and degrees in which these rights ought to be respected by man. The latter subject is lightly touched by Mr. Nicholson in his concluding chapter, entitled "Limitations in Practice." His view appears to be that man has no moral justification in taking the life of any animal, which is not either directly "harmful" to himself or in competition with him in "the struggle for food." Therefore Mr. Nicholson considers it immoral to eat shrimps and lobsters, seeing that they neither "hamper man's comfort nor eat up his food." Criticism here is sufficiently easy. Among animals themselves the only right is might, and therefore if a lobster could argue with a philosopher it is difficult to see on what grounds he could convince the superior animal that the latter has less right to eat him than has his brother lobster. If the lobster were to urge that the philosopher is not merely an animal but a moral animal, the philosopher might answer that he cannot see any moral justification of the lobster's view that the right of an edible animal to live is superior to the right of an eating animal to kill. And if the lobster were unfortunate enough to quote Mr. Nicholson as an authority to prove that man has a moral right to kill only "hurtful" animals, it would be competent for the philosopher to reply that if man has a moral right to promote his own happiness by killing animals which cause him harm or annoyance, it is impossible to see why he should not have a similar right to promote his own happiness by killing all animals that serve him for food. Lastly, if the lobster were to argue that his enemy might secure a doubly beneficial end by limiting his diet only to such animals as are noxious, the philosopher would be compelled to observe that he happened to prefer lobster salad and roast lamb to boiled snakes and rat-pie.

[1] Dr. Whewell is probably the last of competent writers who has done so in the past or is likely to do so in the future. It is remarkable, by the way, that Mr. Nicholson does not quote the passage in which Dr. Whewell sneers at Bentham for maintaining the rights of animals as sentient creatures, for this passage, especially as answered by Mill, would have gone further to argue the existence of obtuseness upon this subject than does any other fact which is mentioned by Mr. Nicholson.

The same inconsistency of principle is displayed where Mr. Nicholson treats of vivisection. He says "much against my feelings I do see a warrant for vivisection in the case of harmful animals and animals which are man's rivals for food." But if man has a moral right to slay a harmful animal *in order to better his own condition*, he must surely have a similar right to slay a harmless animal, *if by so doing he can secure a similar end.* And of course it is the opinion of all sufficiently informed persons that vivisection has been of more service in bettering the condition of humanity than has the destruction, say, of wolves, bears, and tigers, wherever these animals have been destroyed.

OUR BOOK SHELF

Proceedings of the Aberdeenshire Agricultural Association, 1878.

WE have already noticed the earlier field experiments made by this Association. The most prominent fact which they believe they have established is the efficacy of mineral phosphates, when in fine powder, as a manure for turnips. Such phosphates have always been treated with sulphuric acid, and converted into superphosphate before being employed as manure; to employ them in fine powder without this previous treatment would of course be more economical, if they are in this state sufficiently effective.

It would be easy to criticise the experiments on which the above conclusion is based; we might especially point out the very different results which the same manure has yielded on different plots of the same land. The manure has also apparently been incorporated with the soil in a far more perfect manner than would be possible in agricultural practice, and the solvent action of the soil has thus been greatly aided. We must leave therefore any conclusion as to the feasibility of employing finely-powdered apatite or coprolite as a manure until repeated trials have been made on a large scale. There are, however, a few facts in the chemistry of the question to which we should like to call attention.

If we were asked to describe a soil which should exercise the greatest solvent action on phosphate of calcium, we should certainly name one containing much humic matter, and little or no carbonate of calcium. The humic matter, and the carbonic acid produced from it, would act as a tolerably powerful solvent for the phosphate, if carbonate of calcium were not present to neutralise their efficacy. Now the granite soils of Aberdeen belong precisely to the class of soil just described; if, therefore, it should be finally proved that finely-powdered mineral phosphates are almost as effective as superphosphate on land of this character, it will by no means follow that the same result will be obtained if the phosphate is applied to other soils, and especially to those derived from limestone rocks.

As to the effect of nitrogenous manures on the turnip crop, the conclusion first arrived at by the Association has been somewhat modified. In the previous report it was stated that the only effect of nitrogenous manure was to increase the amount of water in the crop; this extraordinary conclusion has not been confirmed by the succeeding experiments. As the turnip crop contains a large amount of nitrogen as a necessary constituent, it is clearly ridiculous to speak of nitrogenous manures as

only capable of increasing the proportion of water in the crop; if nitrogenous manures are found in any case to be of little value, it is not because the plant does not require nitrogen, but simply because the soil supplies an abundance without the aid of manure. Concerning the richness of the experimental soils in nitrogen nothing is said. Mr. Jamieson, the chemist of the Association, has, however, stated in another publication that the Aberdeenshire soils usually contain 0·4 per cent. of nitrogen. If this is the case, there is little reason to wonder at the small effect of nitrogenous manures. The amount of nitrogen just named is far in excess of that usually found in arable soils, and about equal to what we should expect to find in the soil of a well-manured kitchen garden.

The percentage of water in a plant is always increased by anything which increases its luxuriance: a big turnip is sure to contain a greater proportion of water than a little one. If, therefore, we are to condemn manures simply because they increase the percentage of water, we may as well stop manuring altogether. It is quite right, however, that the percentage of water in the produce should be taken into account in comparing the effect of different manures, as it is clear that only the dry matter of the crop can have any feeding value.

The experiments, as before, exhibit a vast amount of painstaking work, and cannot fail, if continued in the same spirit, to be of service to the farmers of Aberdeen.

A History of British Freshwater Fishes. By the Rev. W. Houghton, M.A., F.L.S., Rector of Preston-on-the-Weald Moors, Wellington, Shropshire. Two volumes, extra large 4to. (Copies to be obtained from the author at the above address.)

THE most complete monograph on this branch of natural history which has yet appeared, several species of *Salmonidæ* being illustrated for the first time. The coloured figures and the engraved lake and river scenes, which head each chapter, are admirable works of art. The book is exquisitely got up, and is well suited to the drawing room table. At the same time, it is of real scientific value to the amateur ichthyologist, the descriptions and plates rendering the species of easy identification. The preliminary chapters on the classification and anatomy of fishes are carefully written and well illustrated. The work will add to Mr. Houghton's reputation as an intelligent and accomplished naturalist. C. C.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Price of the "Memoirs of the Geological Survey"

THE publication of Mr. Skertchley's "Manufacture of Gun Flints," in the Memoirs of the Geological Survey, seems to be a good opportunity for again bringing under notice the absurd price charged for some of the Survey volumes. In NATURE, vol. xviii. p. 562, Prof. Boyd Dawkins drew attention to this subject, and urged the necessity of issuing the "Memoirs" at a reasonable price; but this last publication shows that the Stationery Office does not intend to mend its ways, but will still try and put the information it issues as far as possible out of the reach of the public. The fact I should like to draw attention to as regards the price of the "Memoirs" is the absurdity of the amount charged for some of the volumes, as proved by others issued by the Survey; and a glance at the facts seems to show that the prices are fixed without any regard to the size or quality of the book. Mr. Skertchley's pamphlet consists of 80 pp. and 71 figs., and this, in a paper wrapper, is priced 17*s*. 6*d*.! Now, take Prof. Judd's "Geology of Rutland," this contains 320 pp. (or exactly four times as many as Mr. Skertchley's) 11 plates and 19 woodcuts, and the price of this, in cloth, is 12*s*. 6*d*., or 5*s*. less than the one of 80 pp. Another example is Mr. De Rance's Memoir on the "Superficial Geology of the Coasts of South-west Lancashire," which consists of 139 pp., and 20 woodcuts, and for which we have to pay 17*s*.; compare with this Mr. Woodward's "East Somerset and Bristol Coalfield," containing 271 pp., 9 plates, and 23 woodcuts, which is only one shilling more than the last-named, and is issued in cloth. But perhaps the most curious two to take together are Mr. Skertchley's volume on the "Fenland," and Prof. Green's "Report on the Yorkshire Coalfield." The former of these contains 335 pp., 24 plates, and 36 woodcuts, and is published at 2*l*., the latter has 823 pp., 26 plates, and 125 woodcuts, and yet the price is only 2*l*. 2*s*. It is certainly hard to understand why we should be charged 2*l*. for Mr. Skertchley's volume, if one the size of Prof. Green's can be produced for 2*l*. 2*s*. One would imagine that books issued with the public money would be sold as cheaply as possible; and it is to be hoped that some friend to Science in Parliament will ask a question of the Government, and see if it is absolutely necessary that these Memoirs should be published at such famine prices.

Oxford JAS. B. BAILEY

The Sea-Serpent

IN NATURE, vol. xix. p. 286, I observed some remarks respecting sea-serpents, and especially noted one passage which stated that "The age of incredulity is past, and naturalists are now prepared to admit that several distinct kinds of oceanic monsters probably exist."

I was pleased to read this statement, as I have for many years been convinced that some of the accounts published from time to time in the newspapers are accurate descriptions of what has actually been witnessed, but I little expected that I should so soon be able to forward to you a description of one of these creatures, as given by an eye-witness, of whose accuracy there can be no question, and whose observations were made when very close to the animal.

Busselton is a little seaport about 150 miles south of Fremantle, on the west coast of Australia, situated on the shore of Geographe Bay, which is sheltered by Cape Naturaliste; the northern point of that singular projection on the south-west corner of Australia.

During the greater part of the year the water of Geographe Bay is as smooth as a lake, though it is a portion of that vast Indian Ocean which extends unbrokenly to the African coast. The beach is of smooth white sand, so hard at the water's edge that it is frequently used as a road for riding or driving from Busselton to Lockville; the latter place, a few miles to the north, is the station of the Ballarat Timber Company, containing their steam saw-mills, the termination of their railway, and the jetty from which large quantities of that imperishable and valuable timber called jarrah is exported to be used as piles, railway sleepers, &c.

Last month I heard a report that the sea-serpent had been seen near Busselton, and that the resident clergyman had been one of the spectators. Having the pleasure of personal acquaintance with that gentleman, I wrote to him on the subject, and received from him such an interesting account, that I applied to him for permission to communicate the facts to your paper, and verify them by publishing his name. It is fortunate that the principal eye-witness was an educated gentleman, who has for twenty-seven years been a Colonial chaplain in this colony, and whose description of what he saw is clear, simple, and free from exaggeration.

I copy from the letters of the Rev. H. W. Brown the following extracts:—

"On Sunday, March 30, I left Lockville just as the sun was setting, on my way home by the beach.

"The afternoon had been oppressively hot, not a breath of wind, and the sea was as smooth as a glass. I met C. M'Guire and his wife walking towards Lockville.

"Soon afterwards, when abreast of the track to Richardson's, I noticed ahead of me what looked like a black log of wood in the water a stone's throw from the shore, nearly end-on to me, and apparently more buoyant at that end; getting nearer, I noticed that it was *drifting* apparently towards Lockville, and soon discovered that it was moving, leaving behind it a very long, narrow ridge on the smooth water. I then turned my horse's head, and, at a walking pace, kept just abreast of it, un-

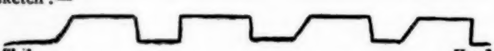
noticed apparently, till I had gained sufficiently on M'Guire to make him hear. I then coo-eed *once;* he turned and came back to meet me; but at the sound of my coo-ee the fish started off seawards out of sight (under water), and doubled again in-shore, but so rapidly as to leave both outward and inward "ridge" on the water distinctly visible at once, like a wide V with quite a sharp corner. It gave me the idea of two fishes, the one darting outwards, the other crossing its track inward at the same moment.

"Not knowing where it might show up next, but satisfied that it had come in-shore again, I tried by pointing seaward to direct M'Guire's attention that way.

"Just as I met him the fish again came to the surface, showing gradually more and more of his length, till, when he was almost at rest, and all apparently was in view, I estimated the length to be 60 feet, straight and taper, like a long spar, with the butt-end, his head and shoulders, showing well above the surface.

"I can only describe the head as like the end of a log, bluff, about two feet diameter; on the back we noticed, showing very distinctly above water, several square-topped fins."

I here make an exact tracing from Mr. Brown's letter of his sketch:—



Tail *Head*

"It was now getting rather too dark to see details distinctly. The fish proceeded towards Lockville, and I turned homeward. M'Guire said he would go on to Lockville jetty and look out for him there.

"Whether he saw him again I know not, but M'Mullan, the fisherman, told me next morning that he had seen it about fifty yards from that jetty, and it looked to him about twenty feet long. So it did to me while in motion; only when at rest for a moment did its whole length show up sufficiently. What its propelling power was I cannot say from observation; I saw no lateral fins and no fish-tail.

"When it started away at the sound of my voice, it was with the rapid movement of a pike or sword-fish, and yet the thick, bluff head had but little resemblance to a snake's.

"There was an unusual abundance of fish close in-shore the same afternoon, yet when I saw the stranger there were certainly no fish of which it could be in pursuit."

Since the year 1848, when the captain and officers of a British man-of-war gave evidence that they passed within 100 yards of a snake which they estimated to be 60 feet in length above water with probably 40 feet beneath, I do not know of any more clear account than the above. Many independent accounts of the existence of marine monsters have been placed on record, and it seems mere folly to treat these repeated reports with ridicule.

I trust that your readers will no longer doubt that "the age of incredulity" is past. H. C. BARNETT,

Fremantle, W. Australia, May 19 Colonial Surgeon

Mechanical Difficulty in Growth of Plants and Animals

IN reading reports and discussions on natural science, to which I am, from great pressure of other occupation and studies, only able to give a cursory attention, I cannot find any allusion to the *mechanical* means by which the growth of organised creatures is produced, especially when that growth takes place in opposition to the direction of gravitation. The explanation at which I have arrived of this phenomenon may probably be known to physiologists, and may have been acknowledged or disproved; any way I think the subject might be fairly discussed in a popular journal such as yours.

The growth of the roots of a plant and of drooping branches not being in opposition to the attraction of the earth, presents only the difficulties which arise from vital action, but the increase of a plant in height requires also explanation as to how the work is done of lifting vegetable matter higher and higher; capillary attraction can bring fluid to the summit of a tube such as the stem of a plant, but the fluid cannot overflow at the top, since in that case the matter of the tube would lift the fluid above itself; but when a tube is full of fluid, additional heat expanding this fluid would cause it to overflow at the top of the tube. As the sap contains solids in solution, from this the fluid could deposit an additional length of tubing, in which again an additional length of the column of fluid could be absorbed, so the heat of each day would build up a higher vertical tube, and capillary attraction would account for the cooler fluids produced at night or rising from the root filling the vessels to their extremities. It seems to me, therefore, that the work done in lifting vegetable matter to the apex of a plant is due to the increase of heat in the daytime; that then the watery particles are evaporated, and the solid left deposited in the form of cylindrical vessels of small bore. In animals the prostrate posture of rest allows of growth without the difficulty of resisting gravitation; it is well known that deficiency of sleep (perhaps more accurately of rest) stunts the growth of animals, and that illnesses which keep children in bed during their years of growth almost always cause a rapid increase of stature; surely this arises from the newly-formed tissues having no gravitation to overcome, and therefore developing rapidly. Probably if a child were taught to take rest in a vertical position, it would not grow tall, but develop in breadth.

The work done in increasing the stature of plants every year must be enormous; in one summer thousands of tons of vegetable tissue must be raised through heights varying from a few inches in an oak, to twenty or thirty feet in a hopbine, and much more in a lliano, or tropical creeper. I presume in winter the cold constricts the vessels, and so prevents sap from rising, hence there is no growth at that season.

Taunton College School H. P. KNAPTON

Chemical Notation

IN Mr. Pattison Muir's very interesting article on thermochemical investigation (NATURE, vol. xx. p. 8, I find the following:—

"That system of notation which is now employed in chemistry, although of the greatest value, is nevertheless far from being perfect; it fails to tell anything concerning the changes in forms of energy involved in those changes of distribution of mass (matter?) which it formulates."

The author does not, however, propose any addition to the usual notation for the purpose of indicating the transformations of energy which take place in chemical transformations, yet this may be done very simply.

The symbol for water is $HO_{\frac{1}{2}}$. This states with perfect clearness the fact that a molecule of water has been formed by the combination of a molecule of hydrogen with a half molecule of oxygen, but it leaves out of account the important fact that in the act of their combination 34462 heat-units have been given out. If we call a heat-unit θ, the symbol for water will then be $HO_{\frac{1}{2}} - 34462\,\theta$; the negative sign indicating that the heat has been *parted with*. I propose to call such compounds thermonegative. Products of perfect combustion, such as water and carbonic acid, are necessarily thermo-negative.

There are thermo-positive compounds, of which protoxide of nitrogen is one of the best understood. According to Fabre and Silbermann, 1154 heat-units are given out in the separation from protoxide of nitrogen of one gramme of oxygen. It is obvious that this heat must have been *taken up* in the formation of the protoxide. Multiplying 1154 by 8 for the equivalent of oxygen, we get 9232 as the thermal equivalent of the protoxide, and we write its symbol $NO + 9232\,\theta$.

Peroxide of hydrogen is usually written HO, but this, from the point of view of chemical structure, is altogether wrong. Fabre and Silbermann "estimate the heat evolved during the liberation of one gramme of oxygen from peroxide of hydrogen at 1363 heat-units. Multiplying by 8 as before, we have 10904 as its thermal equivalent, regarding it as a thermo-positive oxide of water, and we write its symbol

$$(HO_{\frac{1}{2}} - 34462\,\theta) + O_{\frac{1}{2}} + 10904\,\theta.$$

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, July 8

Local Colour-Variation in Lizards

MR. HENRY HILLYER GIGLIOLI remarks (NATURE, vol. xix. p. 97) that the common lizard (*Podarcis muralis*) constantly presents dark varieties on islets adjoining small islands. A similar case has come under my observation in the herpetological fauna of this country. *Ameiva* (cnemidophorus) *vulgaris*, Licht., is very common all over Venezuela, and though it varies considerably in colour, it is, on the mainland, never black, as on the small islands of Los Roques and Orchila, which lie a short distance off our Caribbean coast. Both islands have rather extensive sandy beaches, covered with a very scanty vegetation, so that, *mutatis mutandis*, they are, in the very words Mr. Giglioli uses when speaking of Filfla, painfully white in the glaring

tropical sun, the black lizards being therefore most conspicuous. Prof. Peters, of Berlin, to whom some years ago I sent specimens of these reptiles, called them in one of his letters *Cnemidophorus nigricolor*, but as I am not aware of his having published this name, I believe he got soon convinced of its true character as a melanotic variety. I may be allowed to add that I have mentioned this case already in my "Estudios sobre la Flora y Fauna de Venezuela" (Caracas, 1877), pp. 280, 281, when I also pointed out the difficulty of its explanation by the "struggle for existence" theory. A. ERNST

Caracas, May 15

Intellect in Brutes

1. THE following case was witnessed by my friend Dr. Rafael Villavicencio, of Caracas, during his stay last year in the town of Ponce, in the Island of Portorico:—

The little river in the neighbourhood of the town had risen, in consequence of heavy rains, and ran with rather considerable swiftness. In a certain place it is crossed by a road, where it was forded by a countryman sitting on his mule cart. His dog swam after him, but was taken down by the current and carried back to the bank. Then, after a moment's hesitation, the animal ran some distance up the bank, jumped into the water, and managed to reach the other side just where the road emerged from the river, acting thus precisely as a boatman might have done in similar circumstances.

2. To my friend Dr. Velasquez Level, a respectable physician of this city, and for several years a resident of the Island of Margarita, I am indebted for the following touching instance of the sagacity of a bitch. Her owner, for some reason or other, had destroyed all the female puppies in two successive litters. On her having brought forth a third one it was found that there were but three male puppies. The bitch, however, was observed to leave her whelps occasionally, and to return some time after. Being followed, she was discovered suckling three female puppies, which she had hidden under some brushwood, undoubtedly with the intention of saving them from the master's cruel hands. This case happened in a small place, called Juan Griego, on the northern side of the island. A. ERNST

Caracas, May 15

Intellect in Brutes—a Cat and a Mirror

MANY years ago at Carne farmhouse, where relatives of mine were then living, the household cat was observed to enter a bedroom in course of being spring-cleaned.

The looking-glass being on the floor the cat on entering was confronted with its own reflection and naturally concluded that he saw before him a real intruder on his domain.

Hostile demonstrations were the result, followed by a rush to the mirror and then meeting an obstacle to his vengeance, a fruitless cut round to the rear. This manœuvre was more than once repeated with of course equal lack of success. Finally the cat was seen to deliberately walk up to the looking-glass keeping its eyes on the image, and then when near enough to the edge, to feel carefully with one paw behind, for the supposed intruder, whilst with its head twisted round to the front it assured itself of the persistence of the reflection.

The result of this experiment fully satisfied the cat that he had been the victim of delusion and never after would he condescend to notice mere reflections, though the trap was more than once laid for him. THOS. B. GROVES

Butterfly Swarms

EVEN your varied correspondence from all parts of the world has rarely furnished us with such a wonderfully complete and interesting personal observation as that of Mr. Sydney B. J. Skertchly (NATURE, vol. xx. p. 266) on the West African breeding-grounds of *Vanessa cardui*, and the almost mechanical impulse and simultaneity with which such a swarm as that which he describes free themselves from the pupa-case and set forth on their migration. Can any one throw a similar light on the periodicity of *Colias edusa? V. cardui* is a more constant insect in this neighbourhood than any other with which I am acquainted; but the numbers in June of this year were quite unusual. Also we remarked that they were very high-coloured and vigorous, unlike the ordinary washed-out hybernated specimens of early summer. As one of your correspondents has remarked of his neighbourhood, so here *C. edusa* swarmed in 1877. It was the prevailing insect. In 1878 we had hardly a solitary example. The so-called *C. helice*—the pale variety of *C. edusa*—was frequent in 1877. I saw none of *C. hyale;* indeed, have never seen that insect here. HENRY CECIL

Bregner, Bournemouth

REPORT OF AN UNUSUAL PHENOMENON OBSERVED AT SEA

THE following Report to the Admiralty has been communicated to us for publication by Capt. Evans, C.B., F.R.S., the Hydrographer to the Navy:—

H.M.S. *Vulture*, Bahrein, May 17, 1879

SIR,—I have the honour to inform you that, at about 9.40 P.M. on May 15, when in lat. 26° 26′ N. and long. 53° 11′ E., a clear, unclouded, starlight night, Arcturus being within some 7° of zenith, and Venus about to set; wind north-west, force 3, sea smooth, with slight swell from the same direction; ship on starboard tack, heading west-south-west and going three knots, an unusual phenomenon was seen from the vessel.

I noticed luminous waves or pulsations in the water, moving at great speed and passing under the ship from the south-south-west. On looking towards the east, the appearance was that of a revolving wheel with centre on that bearing, and whose spokes were illuminated, and looking towards the west a similar wheel appeared to be revolving, but in the opposite direction. I then went to the mizen top (fifty feet above water) with the first lieutenant, and saw that the luminous waves or pulsations were really travelling parallel to each other, and that their apparently rotatory motion, as seen from the deck, was caused by their high speed and the greater angular motion of the nearer than the more remote part of the waves. The light of these waves looked homogeneous, and lighter, but not so sparkling, as phosphorescent appearances at sea usually are, and extended from the surface well under water; they lit up the white bottoms of the quarter-boats in passing. I judged them to be twenty-five feet broad, with dark intervals of about seventy-five between each, or 100 from crest to crest, and their period was seventy-four to seventy-five per minute, giving a speed roughly of eighty-four English miles an hour.

From this height of fifty feet, looking with or against their direction, I could only distinguish six or seven waves; but, looking along them as they passed under the ship, the luminosity showed much further.

The phenomenon was beautiful and striking, commencing at about 6h. 3m. Greenwich mean time, and lasting some thirty-five minutes. The direction from which the luminous waves travelled changed from south-south-west by degrees to south-east and to east. During the last five minutes concentric waves appeared to emanate from a spot about 200 yards east, and these meeting the parallel waves from south-east did not cross, but appeared to obliterate each other at the moving point of contact, and approached the ship, inclosing an angle about 90°. Soundings were taken in twenty-nine fathoms; Stiffe's Bank, with fifteen to twenty fathoms, being west about one mile. The barometer was already at 29·25 from 8 to 12 P.M.

	At 8 P.M.	10.15 P.M.	Midnight.
Temperature of air ...	84	83	83
Temperature of sea-water ...	84	82	82

I observed no kind of change in the wind, the swell, or in any part of the heavens, nor were the compasses disturbed. A bucket of water was drawn, but was unfortunately capsized before daylight. The ship passed through oily-looking fish spawn on the evening of the 15th and morning of the 16th inst.—I have the honour to be, Sir, your obedient servant,

J. ELIOT PRINGLE, Commander

GENERAL RESULTS OF EXPERIMENTS ON FRICTION AT HIGH VELOCITIES MADE IN ORDER TO ASCERTAIN THE EFFECT OF BRAKES ON RAILWAY TRAINS

THE experiments were made on the Brighton Railway, with the assistance of Mr. George Westinghouse, with a special four-wheeled van constructed for the purpose; it was attached to an engine, and was run at various speeds, during which time various forces were measured by self-recording dynamometers. The principle of these dynamometers is that the force to be measured acts on a piston fitting in a cylinder full of water, and the pressure of the water is measured by a Richards indicator connected by a pipe to the cylinder; thus, as the drum of the indicator revolves, diagrams are obtained, giving the force acting on the piston. The advantages of this method are obvious, because the indicator can be placed at any convenient point and the inertia of the water tend to make the pencil keep a position corresponding to the mean force. A detailed description of the construction of the dynamometers has been given in the *Proceedings* of the Institution of Mechanical Engineers, but would occupy too much space in this *résumé* of the experiments.

Brake blocks were applied to both pairs of wheels, but the dynamometers were attached to one pair of wheels only. The greater number of experiments were made with this latter pair of wheels, the second pair being reserved for special experiments when the van was slipped from the engine.

The levers for bringing the brakes into operation were so arranged that the brake blocks were applied on both sides of each wheel, and the pressure was equally distributed between the four brake blocks, acting on the pair of wheels.

The dynamometers above mentioned registered (1) The pressure applied to force the brake blocks against the wheels. (2) The friction which took place between the brake blocks and the wheels, due to that pressure, measured by the effort made by the revolving wheel to cause the blocks to revolve. (3) The weight on the springs over the braked wheels at each moment during the experiment, which, added to the weight of the wheels, axles, and springs, gives the weight for calculating the adhesion. (4) The tractive force exerted by the draw-bar. (5) Two self-recording speed-indicators were used, designed by Mr. Westinghouse, one instrument being attached to each pair of wheels. This instrument has been repeatedly tested, and was used at the brake trials on the North British Railway and on the German State Railways. It consists of a small dynamometer made on the same principle as that just described; it measures the centrifugal force of two weights, which are made to revolve by a strap from a pulley on a shaft driven by friction-gear from the pair of wheels to which the brake was applied; a Richards indicator is used, as with the other dynamometers. As the centrifugal force varies as the square of the velocity, the speed is got by taking the square root of the ordinate at any point of the indicator diagram.

The diagrams from one speed indicator showed the speed of the pair of wheels to which the brake was applied, and therefore the velocity of the train at the moment of applying the brake and subsequently, provided there was no slipping. Any variation in the speed-diagram was due to the wheels slipping, and shows to what extent and in what way the brake acted to stop the wheels. The diagrams from the other speed indicator showed the speed of the unbraked wheels. A Bourdon gauge, with the face divided in such a way that the hand showed the speed in miles per hour, was attached, for convenience, to the Westinghouse speed-indicator. As a check upon these, two of Mr. Stroudley's speed-indicators were fixed side by side in the van; one attached to the axle belonging to the braked wheels, the other to the axle which was running free. These indicators do not record the speed.

The indicators were all placed on a table in the centre of the van, and their drums were made to revolve by the cords being wound up on pulleys on a shaft, which was turned at a uniform rate by a water clock. This clock merely consisted of a plunger sliding in a cylinder through a water-tight packing, and loaded with a heavy weight; it was wound up by connecting it with the accumulator which supplied the dynanometers, and at the beginning of each experiment a small cock was opened which allowed the water to run out and the weight to fall, thereby turning the indicators round at an ascertained uniform speed. Thus, while the ordinates of the diagrams taken from these several indicators show the various forces, the abscissæ show the time occupied in the experiments.

In most of the experiments the tyres were of steel, and the brake-blocks of cast iron. Some experiments were made with wrought iron blocks, but the results were not uniform or satisfactory.

Numerous diagrams were taken with this apparatus, but it will suffice here to give the general results arrived at.

It is convenient in looking at the question of railway-brakes to consider first, what is the operation of a brake?

A train through the adhesion of the wheels of the locomotive acting on the rails, slowly accumulates energy, and for each ton of weight in the train, the accumulated energy is equal to 120 foot-tons at 60 miles per hour, 53 foot-tons at 40 miles per hour, and 30 foot-tons at 20 miles per hour. Thus, for a train of fifteen vehicles, weighing 200 tons, the energy at 60 miles per hour is equal to 24,000 tons falling a distance of one foot.

After a train has attained the desired speed, the reasons for stopping it may be of two kinds: (1) at prearranged places for convenience; and (2) for the prevention of accidents or for mitigating the consequences if accidents are unavoidable.

To stop a train for the first reason requires but a limited amount of force, which may be applied in any crude manner.

For the prevention of accidents, however, there is required:—

a. The instantaneous application of the greatest possible amount of retarding force.

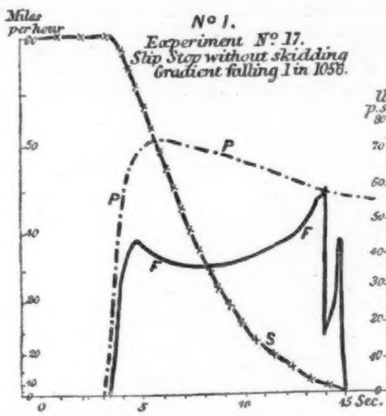
b. The continuous action of this force until the momentum of the train is destroyed.

The retarding force used in practice is that due to the friction resulting from the forcible application of pieces of metals or wood (brake blocks) to the tyres of the wheels; this friction impedes the rotation of the wheels, and tends, through the adhesion of the wheels to the rails, to destroy the energy stored in the train. The retarding force is therefore limited to the resistance obtainable between the wheels and rails.

It was at first customary to attach to a train, for purposes of retardation, a certain number of vehicles with extra weight, to which the brakes were applied; but since the question of retardation has become better understood, brakes have been applied to every vehicle, the means of applying these brakes being placed in the hands of both the engine-driver and the guard. The reason for this is that the maximum amount of retarding force can be obtained only by applying brake blocks to every wheel in the train, each block being pressed with sufficient force to produce a resistance to the rotation of the wheel just equal to the greatest possible friction between the wheel and the rail. This greatest possible friction occurs when the adhesion of the wheel to the rail is just about to be overcome by the superior effort of the brake blocks, which effort, if further increased, immediately begins to stop the rotating movement of the wheel, and thus causes it

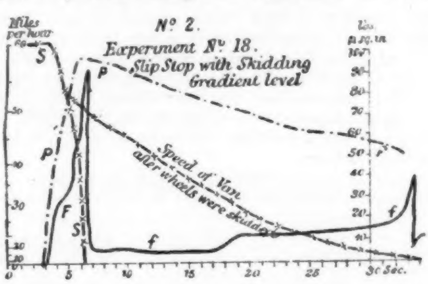
to slide upon the rail. The experiments were made with the object of measuring the force thus brought into action.

The first result of the experiments was to show conclusively that the retarding effect of a wheel sliding upon

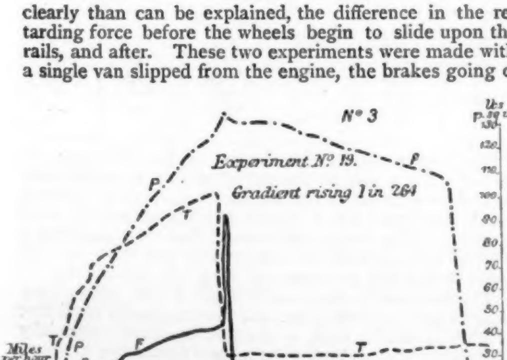


a rail is much less than when braked with such a force as would just allow it to continue to revolve.

The annexed copies of two sets of diagrams (No. 1 and No. 2) taken during the experiments show, more



clearly than can be explained, the difference in the retarding force before the wheels begin to slide upon the rails, and after. These two experiments were made with a single van slipped from the engine, the brakes going on



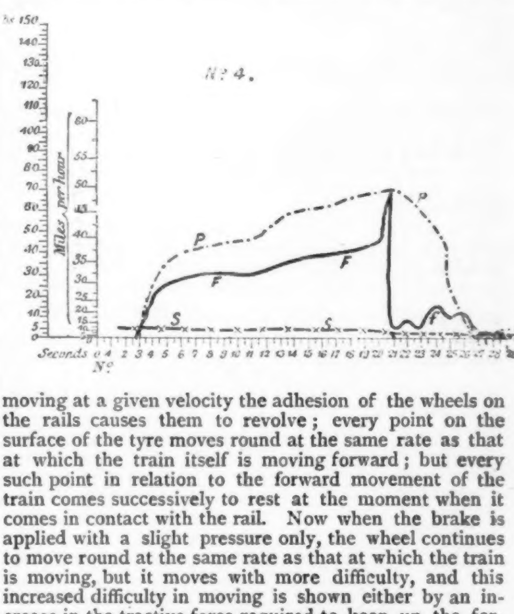
automatically when separation from the engine took place. S is a line showing the speed of the van at each instant, the scale for which is at the left side. P is the pressure against four blocks acting upon one pair of wheels; the vertical height of P by the scale on the right hand multiplied by 240 gives the total pressure in pounds on the four blocks. F is the line showing the retarding effect of the four blocks upon the one pair of wheels before the wheels began to slide upon the rails; and *f* shows the effect while the wheels were sliding upon the rails. The vertical height of F or *f*, according to scale B, multiplied by 60, gives the retardation in pounds. It will be seen that the stop was made in half the time with the wheels braked but not skidded of that required when the wheels were skidded.

The accompanying Diagram 3 shows in another way the comparative retarding effect of the brakes when acting on the revolving wheels and when applied with sufficient force to skid the wheels.

This experiment was made by keeping the van at a uniform speed on a rising gradient of 1 in 264—the line T shows the strain on the draw-bar during the experiment. The line S shows the speed of revolution of the braked wheels, when the revolution was checked and the friction diminished as shown by the line *f*; the strain, T, on the draw-bar diminished in a corresponding ratio.

From this it is evident that the retardation which arises when the wheel is sliding on the rail is far less than the retardation produced by the effect of the brake blocks when applied to the wheels so as to allow the wheels to continue revolving.

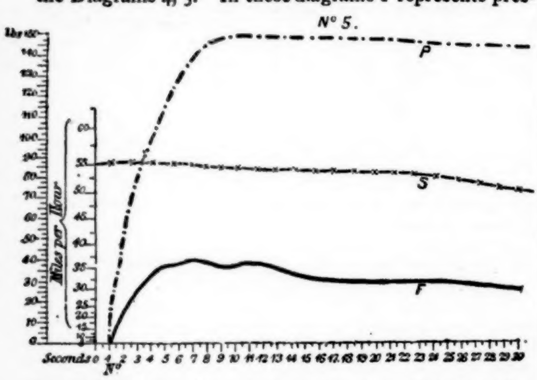
In order to understand this it is necessary to consider the general action of railway brakes. When a train is



moving at a given velocity the adhesion of the wheels on the rails causes them to revolve; every point on the surface of the tyre moves round at the same rate as that at which the train itself is moving forward; but every such point in relation to the forward movement of the train comes successively to rest at the moment when it comes in contact with the rail. Now when the brake is applied with a slight pressure only, the wheel continues to move round at the same rate as that at which the train is moving, but it moves with more difficulty, and this increased difficulty in moving is shown either by an increase in the tractive force required to keep up the forward motion, or, in cases where the accelerating force is not kept up, by the tendency of the moving mass to come to rest in a shorter time than would otherwise be the case. But if the pressure with which the brake is applied be increased, a point is reached when the friction between the brake block and the wheel first approaches, then equals, and finally exceeds, the adhesion of the wheel on the rail. When this happens, the wheel first begins to revolve more slowly, and then ceases to revolve and slides along the rail, or, as it is usually termed, is skidded. The retardation is then no longer due to the friction between the brake block and the tyre of the wheel; but the vehicle is transformed for the time from

a vehicle on wheels into a sledge, and the retardation is due to the excess of resistance which is produced by making the vehicle slide along the rails over that produced by making the vehicle move forward on wheels revolving freely.

The reason why the retardation caused by the brake blocks applied to revolving wheels exceeds that caused by the skidded wheels became obvious from the fact next discovered, viz., that the coefficient of friction between the brake blocks and the wheels varied inversely according to the speed of the train, a higher proportionate percentage of brake-block pressure being required to obtain a given amount of friction at high speeds, and a lower pressure at lower speeds. This is illustrated by the Diagrams 4, 5. In these diagrams P represents pres-

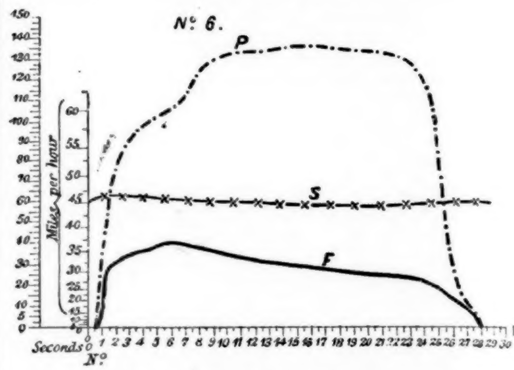


sure, F friction, and S speed, measured on the respective scales at the side to be corrected by the multiple before mentioned; it will be observed that the ratio of F to P in Diagram 4 with a speed of eleven miles per hour is much larger than that of F to P in Diagram 5 with a speed of fifty-five miles per hour.

The following table shows the coefficient of friction obtained from these experiments at varying speeds between cast-iron brake blocks and steel tyres:—

No. of experiments from which the mean is taken.	Velocity.		Coefficient of friction.		
	Miles per hour.	Feet per second.	Extremes observed.		Mean.
			max.	min.	
12	60	88	·123	·058	·074
67	55	81	·136	·060	·111
55	50	73	·153	·050	·116
77	45	66	·179	·083	·127
70	40	59	·194	·088	·140
80	35	51	·197	·087	·142
94	30	44	·196	·098	·164
70	25	36½	·205	·108	·166
69	20	29	·240	·133	·192
78	15	22	·280	·131	·223
54	10	14½	·281	·161	·242
28	7½	11	·325	·123	·244
20	Under 5	Under 7	·340	·156	·273
	Just moving		—	—	·330
Fleeming Jenkin		·0002 to ·0086	·337	·365	·351
Static friction (Rennie)					
180 lbs. per square inch	—		—		·300
336 lbs. per square inch	—		—		·347

If the position of the brake-blocks were always the same at the same speed, some simple rule might be deduced which would give the pressure required at each speed for obtaining a certain amount of retardation; but when the speed of the van was kept nearly uniform by the effort of the engine, the friction of the blocks decreased; and this occurred notwithstanding a continued increase of the brake-block pressure: showing that, through some cause not yet fully determined, the holding-power of brake-blocks at all speeds is considerably less after some seconds of application than when first applied. This peculiarity is illustrated by Diagram 6, and is also



apparent in Diagram 5. Hence the question of the proper amount of brake-force needed at each instant, during the time required to stop a train, is still further complicated by this decrease which occurs in the coefficient of friction after the brakes have been applied, and which results from the time during which they are kept applied, irrespective of any change in speed. This decrease in the coefficient of friction is shown in the following table:—

Coefficient of Friction as affected by Time

Speed. Miles per hour.	Coefficient at commencement of experiment.	After 5 seconds.	After 10 seconds.	After 15 seconds.	After 20 seconds.
20	·182	·152	·133	·116	·099
27	·171	·130	·119	·081	·072
37	·152	·096	·083	·069	—
47	·132	·080	·070	—	—
60	·072	·063	·058	—	—

Diagram 7 shows the curves of this decrease obtained from a few of the experiments. It would seem as if the coefficient of friction due to each speed becomes nearly uniform after a certain number of seconds have elapsed. The experiments were, however, necessarily limited to something between twenty and thirty seconds each, so that this point has not been fully determined.

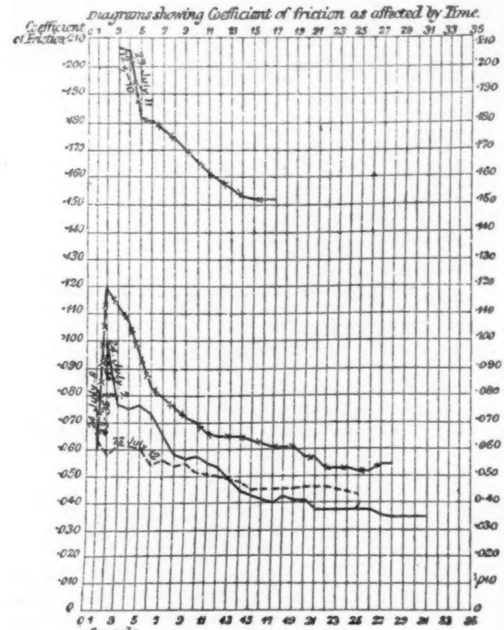
The decrease in the coefficient of friction, arising from time sometimes overcomes the increase in the coefficient of friction arising from a decrease in speed; especially when, either from the stop being on a descending gradient or from a small proportion of the train only being fitted with brake power, the train takes considerable time in coming to rest. Therefore, a higher brake pressure is required in such cases than when the stop is made in a short time.

The accompanying diagram (8) shows a uniform force of friction with a practically uniform speed, as obtained by means of an increasing brake-block pressure. The line P, shows the pressure, F the friction, and S the

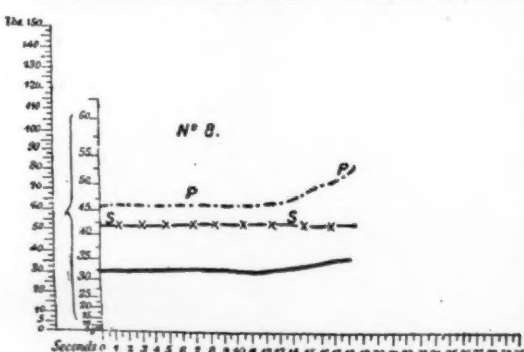
speed, which decreased slightly during the experiment, and would have caused an increase in the coefficient of friction had it not been counteracted by the element of time.

There is nothing unnatural in the fact that friction decreases with speed. Friction is mechanical work; it re-

No. 7.

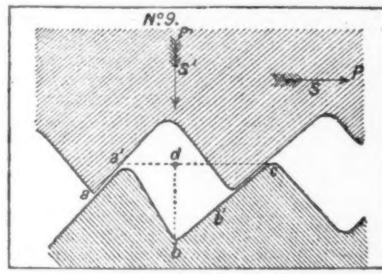


quires a definite force to move a body which is in contact with another, and such movement causes a perceptible wear of the surfaces in contact. The manner in which this work is accomplished can be explained only by the fact that the surfaces in contact are not perfectly smooth, but irregular, although this irregularity may not be distinctly visible to the naked eye. These surfaces, if exa-



mined under a sufficiently strong microscope, would be found to be somewhat as represented in the accompanying diagram, No. 9.

If the upper body be moved in the direction of the arrow, S, by a force, P, the point, *a*, of the upper surface would mount the incline, formed by the corresponding portion of the lower body, until it reached its summit at *a'*; from this moment it would begin to descend the next incline, from *a'* to *b*; provided the force, P, acting in the direction of the arrow, S, would leave it time to do so, the incline from *b* to *c* would have to be mounted next, causing a certain amount of resistance during the time the body traversed the distance *d c*. But if we increase the speed in the direction of the dart S, so that the body will require less time to traverse *a' d* than to fall through *d b*, in such case *a'* would not arrive at *c*, but at some other point, *b'*, and then only the portion of the



incline *b' c* would have to be mounted, presenting a smaller amount of resistance than in the former case. This illustrates what occurs.[1]

The fact that the coefficient of friction diminishes with speed sufficiently explains why a skidded wheel affords less resistance than one which still rotates, because the resistance occasioned by the rotating wheel is only limited by the adhesion of the wheel on the rail, and this, as already shown, is the same as static friction, since the point of the wheel is stationary as regards the forward movement of the train at the moment it touches the rail; whilst when the wheel is skidded and slides, the friction is that due to the speed at which the wheel moves on the rail, and is therefore less than the other.

DOUGLAS GALTON

(*To be continued.*)

GEOGRAPHICAL NOTES

ON Monday the French Geographical Society held an extraordinary meeting, in the large hall of the Sorbonne, for the reception of Major Serpa Pinto, the African explorer. We understand that Major Serpa Pinto and Lieut. Lucien N. B. Wyse have both promised to attend the coming meeting of the British Association at Sheffield, and will give accounts of their recent explorations in Africa and the American Isthmus. Some other very interesting papers, we hear, are in preparation for the geographical section, over which Mr. Clements R. Markham will preside.

THE principal novelty in this month's Petermann's *Mittheilungen* is an elaborate paper "On the Geographical Distribution of some Plague Epidemics," by Dr. Carl Martin. Dr. Emin Bey has a short paper "On the River Obstructions of the Bahr el Jebel," and we regret to say, Dr. Gerhard Rohlfs writes from Bengazi on June 10, that he has resigned the leadership of the expedition of the German African Society, which was organised for the purpose of reaching the Congo by starting from Tripoli. Dr. Rohlfs gives as his chief reason for resigning, the length of time the expedition is likely to last, and the value of even a single year at his age. He has, however, done his best to remove all difficulties from the way of the expedition in setting out, and these have not been few. He proposes Dr. Stecker to succeed him, and hopes the

[1] This simple illustration is taken from an article in the *Chicago Railway Gazette*, by M. Krajewski.

Society will approve. Though Dr. Rohlfs' resignation is to be regretted, he cannot be blamed, and we trust the expedition will be able to carry out its original programme.

THE French Government will present to their Parliament a bill for taking preliminary steps in order to establish a Soudan railway from Algiers to Senegal, *viâ* Timbuktu. An official commission has been appointed to report on that subject.

THE *Engineering and Mining Journal* states:—At a late meeting of the New York Academy of Sciences, Prof. Arnold Guyot, of Princeton College, presented before the Geological Section a paper upon "The Topography of the Catskills," containing the results of several years of study of these mountains, and which he is about to publish. From the contents of this interesting paper, it will appear, that this region of country—in the midst of the oldest settlements, and long celebrated as a summer resort—has remained comparatively an unknown wilderness, even to this day; for Prof. Guyot, within the past few summers, has actually discovered and named an extensive group of mountains rising into peaks in some cases over 4,000 feet high (the "Southern Catskills," or "Shandakeens"), which are not laid down on any map, or described in any gazetteer. These works of reference refer to this region as "a hilly country," merely, and the fact that it contains mountains higher than the true Catskills, is quite new to science, and it has been reserved to Prof. Guyot to make an interesting geographical discovery in the very heart of the State of New York. For the paper *in extenso* our readers are referred to the *Proceedings* of the Academy, and for a fuller abstract, to the *American Naturalist* for July, to which we are indebted for the brief notice here given.

CAPT. JAMES B. EADS, who is constructing the jetties to deepen the channel at the mouth of the Mississippi River, has written a letter to the *New York Tribune*, in which he proposes to substitute for the contemplated ship canal across the Isthmus of Darien a railway by which the largest vessels may be conveyed across in twenty-four hours. This project he claims to be entirely practicable, and says it would cost considerably less than the canal, and might be completed in three or four years. The ship could be raised by a lock and the usual hydraulic methods, and he suggests two methods that are practicable, and with precautions to prevent straining. He recommends turn-tables instead of curves in the railway where changes of direction are necessary. The car, or cradle, to carry the ship should be built in sections, each about 100 feet long, and each section supported by about 200 wheels, some of them driving wheels moved by engines. The weight of the largest merchant steamers and their cargoes would not exceed 10,000 tons. Such a vessel Capt. Eads would place on five of these sections, supported by 1,000 wheels bearing on eight or ten rails, so that each wheel would support about 12 tons. He thinks his plan entirely practicable, and urges it very strongly. Indeed the scheme adopted at the recent conference for an interoceanic canal meets with no favour in America, and Mr. Troutwine thinks it will never be finished, the difficulties are so great. Perhaps national, as much as engineering reasons, influence American opinion on the subject.

DR. H. A. A. NICHOLLS, who, we believe, is Surveyor-General of Dominica, has addressed to the *Colonies and India* some notes of considerable interest on that little-known island and its boiling lake. In many parts, he tells us, fine undulating uplands extend from the heads of the valleys far into the interior, and one runs across the broadest part of the island at an elevation of 800 feet above the sea, containing many thousands of acres of fine, well-watered land, with a virgin forest of lofty timber trees. The chief mountain peak reaches a height of 4,747 feet. Only a small portion of the island is cultivated, but of the rest, which is covered with the primeval forest, large tracts are suited for the growing of coffee, cocoa, spices, limes, and other tropical products. The Boiling Lake, which is at an elevation of 2,425 feet above the sea, has been visited on three occasions by Dr. Nicholls, who, on his second visit, ascertained that the temperature at the edge was 180° F., gradually increasing towards the centre. The lake was first seen in recent times by an exploring party organised and led by Mr. Watts, a colonial magistrate, and Dr. Nicholls. They thought they were its discoverers, but it has been found that the volcano is mentioned in a very rare medical work published in 1797.

PROF. GEORG GERLAND concludes in the current number of *Globus* a long and elaborate examination into the future of the American Indians. The conclusion he comes to is that facts do not warrant the inference that the Indians are dying out, nor that they have been deleteriously affected by contact with civilisation.

IN the course of this month a highly interesting geographical work will be published by Karl Graeser, of Vienna, by order of the Austrian Minister for Education. Its author is Prof. Friedrich Umlauf, and its title "Wanderungen durch die oesterreichisch-ungarische Monarchie; landschaftliche Characterbilder in ihrer geographischen und geschichtlichen Bedeutung."

THE second International Congress for Commercial Geography will take place at Brussels from September 27 to October 1 next. It will be divided into five sections; the first will consider commercial routes and exploring expeditions, the second natural and artificial products, the third and fourth questions relating to emigration, colonisation, and instruction, while the fifth section will be devoted to the discussion of general questions.

HERR CARL BOCH, who has now finished his natural history exploration of the western highlands of Sumatra, is about to explore, on behalf of the Dutch Government, the north-eastern part of Borneo—the district of Koetai. There is a powerful and friendly Sultan at Koetai, who has been requested by the Dutch Government to give all possible assistance to Herr Boch.

ONE of the newest of French geographical societies, that of Montpellier, which has assumed the title of Société Languedocienne de Géographie, now publishes a *Bulletin* about every two months, which for size is imposing enough, for the last number runs to 180 pages. It contains, among other matter, observations on the creation of an inland sea in the Eastern Sahara, and papers on Natal, the Transvaal, and Zululand, and on the River Ogowé, as well as a summary of M. Soleillet's account of his recent attempt to reach Timbuktu, *viâ* Ségou.

A NEW project for the construction of a system of canals connecting the Caspian Sea with the Black Sea is now being considered by the Russian Government, and is discussed in a recent number of the *Journal* of the Russian Imperial Office for Public Works of Communication. The author of the new project is the engineer, M. A. Daniloff. He proposes to construct (1) a canal of some 300 versts in length, from the River Terek to the water-shed of the River Manytsch, which connects the Don with the Caspian Sea, but the bed of which is generally dry; (2) a canal of about 320 versts, from the mouth of the River Kalans (a tributary to the Manytsch), eastward to the Wolga, near Astrachan; (3) a canal from the same spot, westward to the Don (about 350 versts); (4) a branch from the eastward canal to the Serebriakowskaya Station on the Caspian Sea; (5) a branch from the westerly canal to the Black Sea. Other Russian news states that the Government has commanded the Khan of Khiva to furnish 5,000 workmen for the works connected with directing the Oxus River into the Caspian Sea.

PROF. MOEBIUS ON THE EOZÖON QUESTION[1]

II.

HAVING described the Eozöon sufficiently to enable the reader to follow its comparison with foraminifera, Prof. Moebius proceeds to the description of the structure of these animals. Fig. 12 represents a longitudinal section of *Tinoporus baculatus*, magnified 150 times. This foraminiferal species occurs very frequently upon the coral reefs of the Samoan Islands in the Pacific. Its shell consists of a bi-convex middle part, from which at

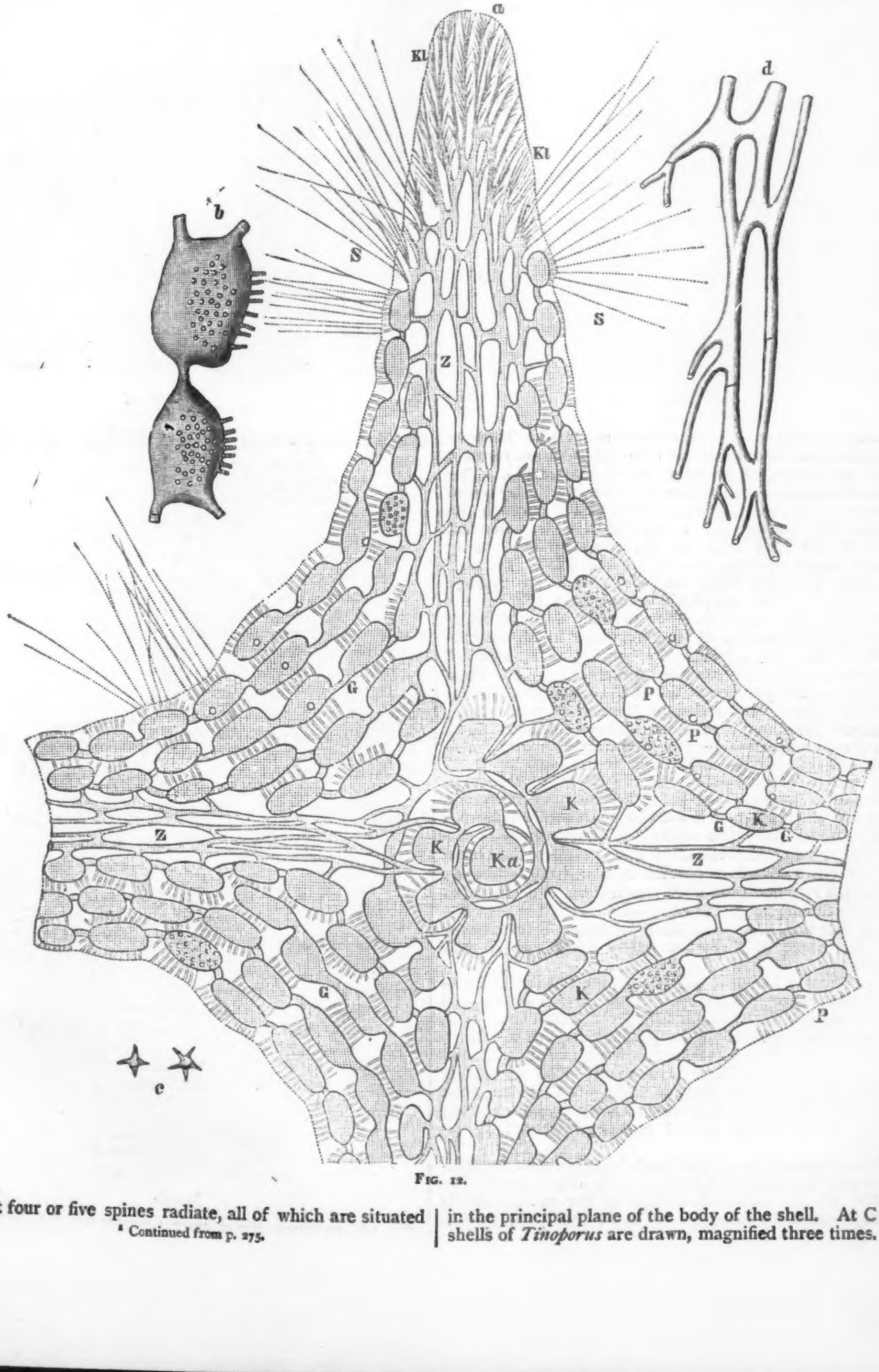


FIG. 12.

least four or five spines radiate, all of which are situated in the principal plane of the body of the shell. At C two shells of *Tinoporus* are drawn, magnified three times.

[1] Continued from p. 275.

In the centre of the larger figure we see the globular germ-chamber of the animal (K*a*) round which the next

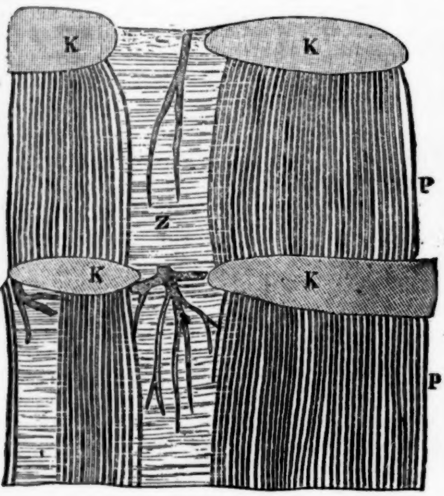


FIG. 13.

FIG. 14.

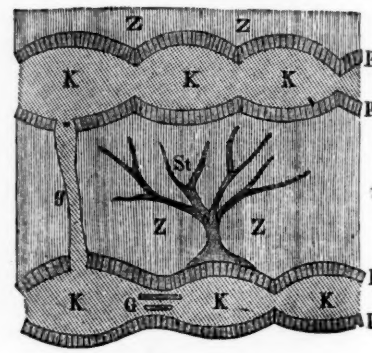


FIG. 15.

following chambers (K) are spirally arranged. Then in four directions curved rows of chambers (K) are formed, which are separated by intermediate matter (Z). The chambers communicate with each other, partly by round passages (G), partly by pore-canals (P). Through the intermediary matter (Z) a canal-system is extended, which in the long arms of the shell ends in many minute canals opening to the surface (K*l*). Through the pores of these little canals, as well as through the orifices of the peripheric pore-canals (P) of the outer rows of chambers, the sarcode, *i.e.*, the gelatinous body-substance of the animals, is in communication with the outside. In some parts protruded, granular sarcode filaments are represented (S, S); these are the so-called pseudopodia. At C we see two chitinous chamber-linings with adherent linings of pore-canals, magnified 350 times; at *d* are drawn chitinous ducts from the canal-system in the intermediary matter, also magnified 350 times, and freed from lime by treatment with dilute chromic acid. Fig. 13 represents a small part of a cross section of a tertiary *Nummulina*, magnified 220 times. K K are the chambers which were filled with sarcode. The superposed chambers communicate by means of pore-canals (P P). Between the chambers there is a deposit of poreless intermediary matter (Z), into which ramified canals are penetrating. Fig. 14 shows five pore-canals, magnified 500 times. Here it is seen distinctly that they are round tubes separated by calcareous matter. Some of them are partly filled with a dark material.

According to Dawson and Carpenter the limestone of the Eozöon represents the shell of the Eozöon animal, and the serpentine the material filling the chambers. Thus the serpentine now takes the place of the sarcode which once lived in these chambers, and which from its substance secreted the lime as a shell. The serpentine patches of the fossil Eozöon, according to this view, have the same shape and size which the separate chamber bodies of the living animal possessed when fully extended.

The separate fibres of the bands lying between the limestone and the serpentine, according to Dawson and Carpenter, are the siliceous fillings of the minute canals through which the sarcode body could send pseudopodia-filaments into the water outside of the shell. The simple

FIG. 16.

and the ramified stems in the limestone are siliceous

fillings of canals in which the Eozöon sarcode extended through the calcareous intermediary matter.

Dr. Carpenter represents this view of the different parts of Eozöon by a systematic drawing, which we give in Fig. 15. K, K, K are two rows of chambers filled with serpentine. The narrow parts between the chambers correspond to the round passages of foraminifera. In the lower row of chambers, at G, the communicating passage between two chambers is divided into three narrow ducts by two plates which lie embedded here. P, P represent the walls of the chambers penetrated by the fine pore-canals, in the places of which in the real Eozöon fibres of chrysotile are now situated. Z, Z is the intermediary matter of the Eozöon shell, into which the ramified canals (St) (the present stems of the Eozöon) are protruding. Towards the left, at *g*, a chamber duct is represented, which unites two chambers of different rows or layers. Chamber ducts of this kind occur in *Tinoporus baculatus* (Fig. 12), for instance, and also in other living foraminifera.

Prof. Moebius then proceeds to compare one by one the different parts of Eozöon with those parts of foraminifera to which, according to the views of Dawson and Carpenter, they are supposed to correspond.

1. If the patches of serpentine are the filling materials of the Eozöon chambers, then they represent their cavities plastically in a similar way, as the stone kernels of echini, gasteropoda, and ammonites represent the interior cavities of the shells of these animals.

The relative sizes of the serpentine patches vary very much. The longitudinal axes of the largest ones are about thirty times as large as those of the smallest. Their absolute sizes vary from a few millimetres in length and 0·5 mm. in height, to 20-30 mm. in length and 5-10 mm. in height.

The serpentine patches of Eozöon are in form and arrangement, as well as in relative size, very unlike the chambers of most foraminifera. In their shapes none of the fundamental forms are reproduced again and again, which in all the chambers of a foraminifera species point back to one and the same law of formation. Neither the fundamental shape of a ball or lentil, nor the shape of a crescent or sickle, which occur in the different foraminifera species, form the basis of the serpentine patches of Eozöon. Yet there is a certain regularity in their shape and arrangement. Frequently they have contours similar to crystals of olivine (Fig. 10). Generally they form concavo-convex layers which are superposed and are separated by layers of limestone (Fig. 1). In many pieces an increase in size of adjacent serpentine patches in one direction may be observed. In many others ball-shaped or oval serpentine patches are arranged in such a manner that they form a spiral (Figs. 3 and 4). But this arrangement does not give the impression of a *genetic* succession, as is the case with the chambers of spiral foraminifera.

2. The fibres, forming band-like spaces between the serpentine and the limestone are supposed to be the siliceous fillings of fine pore-canals which penetrated the calcareous chamber-walls of the Eozöon shell.

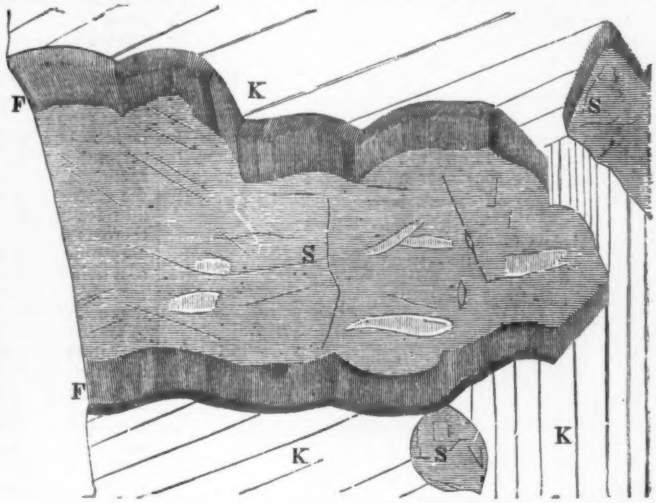


FIG. 17.

The pore-canals in the chamber-walls of foraminifera are cylindrical tubes, separated by calcareous intermediary matter. Thus every tube runs *isolated* through the chamber-wall (Figs. 12, 13, and 14). The fibres of the Eozöon, however, are prismatic needles or little plates, which are situated close together (Figs. 10 and 11), and

FIG. 18.

therefore they cannot represent the fillings of cylindrical tubes in another material. In no sections, neither in those which cut through them at right angles, nor in others which exhibit them obliquely, nor in those which are parallel to their axis, any traces of an intermediary substance separating the single fibres can be found. Also in polarised light the fibre bands appear altogether homogeneous and consisting only of *one* kind of material.

The pore-canals penetrate the chamber-walls of the foraminifera in such a direction that to the sarcode filaments, which, as pseudopodia are sent forth from the chambers into the water outside, they offer the shortest possible way (Figs. 12 and 13). Thus as a rule they lie at right angles to the inner and outer surfaces of their

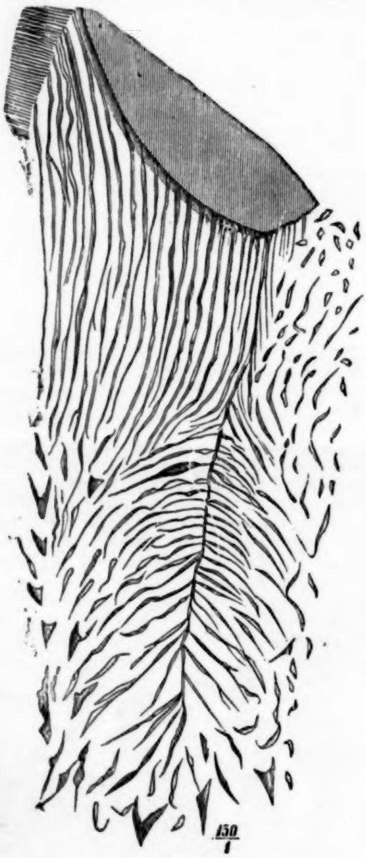


FIG. 19.

chamber-wall, as long as this continues to get uniformly thicker by the deposition of regular layers. If the thickening of the chamber-walls takes place in an irregular manner, then it often happens that the pore-canals are curved; yet even in this case the tendency of the sarcode to reach the outside water through the new thickening layers of its chamber-wall by the shortest possible way becomes apparent. This law is manifest even with the simplest forms of foraminifera, the chambers of which are not even of regular shape and arrangement. Fig. 16 illustrates this; it represents a section of *Carpenteria rhaphidodendron* magnified 120 times; K K are chambers, P P pore-canals.

In the direction of the Eozöon fibres, which are supposed to correspond to the pore-canals of foraminifera, a similar organic regularity is altogether missing. It is true that in many places they radiate from the surface of the serpentine patches, which are supposed to be the fillings of foraminifera chambers, at right angles towards the limestone; yet the direction of the fibres in these places cannot be said to represent the direction of the sarcode of a foraminifera species, because in adjacent parts the direction of the fibres does not always obey the same law, and because for great distances in the fibre bands all the fibres retain a parallel direction, no matter whether they lie at right angles, obliquely, or even tangentially to the serpentine patches. This is shown in Fig. 17, representing a section of Eozöon magnified ninety times; in the centre is a serpentine patch, S, surrounded almost on all sides by parallel chrysotile prisms; above to the right there is a smaller patch of serpentine, surrounded by chrysotile fibres of the same direction. The pseudopodia of a living sarcode mass, which once took the place of the serpentine, cannot therefore have determined the direction of the fibres; on the contrary, their parallelism points to an *inorganic* origin, because it is independent of the curvatures of the boundaries between serpentine and limestone.

3. The stems in the limestone of the Eozöon are supposed to be the siliceous fillings of ramified canals in the intermediary matter of the Eozöon shell. In good sections the stems generally look brownish in transmitted light; whitish or colourless ones are much less frequent. Their shape, size, direction, and quantity vary extremely, not only when different sections are compared, but very often already in different parts of the same section, even if this measures only a few millimetres in length and breadth. The stems may lie so close together that the spaces intervening are hardly larger than their own diameters (Fig. 18); often they are separated by wide intervals (Figs. 5 and 18). Sometimes they run parallel (Fig. 18), at other times they radiate from one or more points, or assume the shape of feathers (Fig. 19). They touch the boundaries of the limestone or are imbedded in the midst of this (Figs. 5 and 18); they are simple (Figs. 18 and 19) or ramified (Figs. 5, 9, 10, and 18), long and slender or short and broad. They terminate in fine points or in the shapes of clubs or spoons. They are straight, bent into knee shapes, curved like waves, or folded and twisted irregularly.

Their sections generally have sharp edges; round or elliptical sections, like those of the ramified canals of foraminifera, are rare amongst them. The sizes and shapes of successive sections of one and the same stem may also vary considerably.

Prof. Moebius concludes his treatise with the following characteristic sentences:—"My task was to examine Eozöon from a biological point of view. I commenced it with the expectation that I should succeed in establishing its organic origin beyond all doubt. But facts led me to the contrary. When I saw the first beautiful stem-systems in Prof. Carpenter's sections, I became at once a partisan of the view of Professors Dawson and Carpenter; but the more good sections and isolated stems I examined, the more doubtful became to my mind the organic origin of Eozöon, until at last the most magnificent 'canal-systems' taken all together and closely compared with foraminifera sections preached to me nothing but the inorganic character of Eozöon over and over again.

"In the minds of other zoologists, while showing them a series of my finest Eozöon sections, stem preparations, and foraminifera sections under the microscope, I have repeatedly in the course of an hour called forth these mental metamorphoses, which I passed through in the course of a long period of investigation.

"I am heartily sorry that, by way of thanks for the extremely kind support which Professors Dawson and Carpenter have given me in these investigations by

sending me beautiful Eozöon pieces, I cannot say to them: According to my investigations also *Eozöon canadense* must be regarded as a fossil species of foraminifera. I am convinced that both, like myself, had the honest intention to represent correctly the true nature of Eozöon. But they must own that in their descriptions they did not investigate so closely nor describe so minutely the shapes nor the relative positions of the various parts, as I have done in my treatise. If they had done this then I believe that the facts would have led them to the same conclusions which they forced upon me.

"If the Eozöon pieces from the Laurentian or 'Urgneiss' formation were really remains of an undoubted foraminifera species, then we should possess in them *certain* proofs that even during the formation of the most ancient strata of the earth's crust living beings occurred, and that the first organisms belonged to the lowest animals, by which biology and geology would have gained two highly important facts. Yet by the scientifically justified elimination of Eozöon from the domain of organic beings it is not proved that during the Laurentian period no living beings existed. Perhaps the graphite of the Urgneiss formation has its origin in organic beings.

"The proof that Eozöon is not a fossil rhizopod will perhaps for many persons take away an important link from the beautiful picture of the development of organic life upon the earth, which they may have drawn up for themselves. But the object of natural research does not consist in finding reasons for attractive conceptions about nature, but in knowing nature as it really is. Because only an insight into the real condition of nature can, in the long run, satisfy the scientific mind, which gives up as errors the most attractive hypotheses regarding the essence and action of nature, if in the face of newly discovered facts they can no longer hold good, no matter whether these erroneous hypotheses may have reigned supreme for a long time previously, and may have been held to be the best conceptions of nature by the most eminent authorities."

THE BLOWPIPE CONE-SPECTRUM, AND THE DISTRIBUTION OF THE INTENSITY OF LIGHT IN THE PRISMATIC AND DIFFRACTION SPECTRA

NOW that the optical properties of the blowpipe blue cone have been so critically investigated, may I draw the attention of the readers of NATURE who are interested in the history of spectrum analysis, to what I think are the earliest experiments on that subject. They were published by me in 1848. The memoir in which they are reprinted may be found in my "Scientific Memoirs." It contains a woodcut of the five rays, adjusted to a reference solar spectrum on page 64, and another of the five images of the cone on page 69.

Let me also refer to some experiments I have recently made on the distribution of the intensity of light on the spectrum, by the aid of a new form of spectrometer, which depends on the well-known optical principle, that a light becomes invisible when it is in presence of another light about sixty-four times more brilliant.

In a memoir I am now publishing in the *American Journal of Science*, and which, I presume, will also appear in the *Philosophical Magazine*, I have described several modifications of this instrument. The following is one easily made:—

Remove from the common three-tubed spectroscope its scale-tube, and place against the aperture into which it was screwed a glass ground on both sides. In front of this arrange an ordinary gas light attached to a flexible tube, so that its distance from the ground glass may be varied at pleasure. This light I call the extinguishing light. On looking through the telescope-tube the field of view will be found uniformly illuminated, this being the use of the ground glass, the light of which is reflected from the prism. The brilliancy of the field depends on the distance of the extinguishing light from the ground glass, according to the ordinary photometric law.

Now, if another small gas flame be set before the slit of the instrument, on looking through the telescope its spectrum will be seen in the midst of a field of light. If the illumination of that field be made very brilliant, the spectrum will be extinguished; if feeble, all the coloured regions appear. By moving the extinguishing flame to proper distances, it will be found that the violet region is the first to disappear, the red the last. The yellow by no means resists longest, as it ought to do if it were the most brilliant. Hence it follows that in the prismatic spectrum, the red and not the yellow is the brightest ray.

If the cause of the increasing intensity of light in the prismatic spectrum, from the more to the less refrangible region, be the compression exercised by the prism on the coloured spaces, increasing as the refrangibility is less, we ought not to find any such peculiarity in the diffraction spectrum. In this the coloured spaces are arranged uniformly, and without compression in the order of their wave-lengths. An extinguishing light ought to obliterate them all at the same moment.

Having modified the common spectroscope by taking away its dark box, so that the slit-tube and the telescope tube could be set in any required angular position to each other, I put in the place of its prism a glass grating, inclined at 45° to rays coming in through the slit. The ruled side of the grating was presented towards the slit. Now when the extinguishing flame was properly placed before its ground glass, the plane face of the grating reflected its light down the telescope-tube. In this, as in the former case, the spectrum of a small flame before the slit was seen in the midst of a field of light, the intensity of which could be varied by varying the distance of the extinguishing flame. It was now found that as the brilliancy of the extinguishing illumination increased, all the coloured spaces disappeared at the same moment, and on diminishing the illumination all the colours came into view at the same time. As long as the red was visible the violet could be seen.

From this it follows that in the diffraction spectrum the luminous intensity is equal in all the visible regions. In the memoirs now publishing I have applied these facts to the case of the spectrum distribution of heat.

JOHN WILLIAM DRAPER

University of New York

THE NEW THERMO-ELECTRIC LIGHT BATTERY

IT appears that a difficulty which it has long been the ambition of practical electricians to overcome has at last been solved by M. Clamond. According to his statement, published in *La Lumière Electrique*, which is confirmed by the Count du Moncel, M. Clamond has succeeded in producing the electric light by means of his new thermo-electric battery. M. Sudré has also just published his design for a powerful thermo-electric battery, but we do not know whether this system has yet been put to any practical trial, whereas that of M. Clamond is now in actual use for the purpose of lighting certain factories in Paris. Full details of either system have not yet come to hand, so that it is only possible to state the general results at present obtained.

That heat could be transformed into electrical energy was first discovered by Seebeck in 1822, who found that an electric current was produced when the junction of two dissimilar metals was heated. Little use, however, was made of this discovery as a source of energy, owing to the feebleness of the current to which it gives rise, although it has been of great service since the time of Forbes and Melloni in the investigation of radiant heat.

Prof. Bunsen, by the employment of different metals from those hitherto tried, found that he could increase the strength of the current, and M. Marcus, of Vienna, using alloys instead of simple metals for the positive and negative element, reduced the cost, while increasing the power of the battery. From a thermo-electric battery constructed on his principle, and also from a modified form, devised by Wheatstone, a current sufficiently strong to produce brilliant sparks, decompose water, &c., was obtained. This was in 1865, and but little progress has, until now, been made in this branch of science, with the exception of the improved forms of thermo-pile devised by Noë and by Messrs. C. and L. Wray, although the utilisation of heat—especially solar heat—for the production of electricity has long attracted the thoughts of many experimenters.

M. Clamond has for some time been at work upon the subject, and has so far succeeded that his thermo-electric battery has been employed since 1875 in M. Goupil's factories. These batteries are formed of iron, as the electro-positive element, and an alloy of antimony and zinc for the negative; they are soldered together and arranged in a circular form, which can be built up as high as may be desired. The junctions of the metals are heated in the interior, but the electromotive force being proportional to the difference of temperature between the two extremities of each bar, it was necessary to make the bars long if a strong current was desired, and then the results were less satisfactory, owing to the increased internal resistance, the melting of the metals where they were soldered, &c.

It is these hindrances to its extended use which M. Clamond has sought to obviate in his latest form of battery, which is composed of three distinct parts. The *collector* consists of a number of pieces of cast-iron so arranged that the heated air can circulate within them; a large surface is thus exposed to the heat, which the iron collects and communicates to the couples. The *diffuser* is the outside of the apparatus, and is made of sheets of metal. The *thermo-pile proper* is placed between these two, and is so arranged that the junctions of the metals are alternately at the temperature of the collector and the diffuser. Heat passes from the collector to the diffuser along these couples, which have no great length. In some forms which are very easily worked, a number of these couples are made into a flexible chain of any desired length, the extremities forming the poles of the battery. These chains, insulated from the other parts of the apparatus, can be united to each other by their free ends, so that a variety of couplings and combinations may be made. The model now in use for lighting a workshop in Paris is about 2½ metres high, and 1 metre in diameter, the exterior form being that of a polyhedron, to the sides of which the thermo-electric chains are attached; these are composed of small cubes of zinc and antimony joined together by plates of tin, to which they are soldered. Each half of the apparatus has 30 chains of 100 couples each, or 6,000 couples in all. To the outer surface of these chains are fixed the sheets of copper which form the diffuser or heat distributor.

Another model, made for the recent exhibition at the Albert Hall of the various systems of electric lighting, is square and much smaller, though of the same power.

Each half of the cylindrical battery can be made to supply a powerful electric light, while the square one can produce *four* lights of half the brilliancy. The electromotive force is, according to prolonged experiments, 218 volts, about equal to 120 Bunsen cells, while the resistance is 31 ohms. The large battery consumes only 9 or 10 kilogrammes of coke an hour, and the smaller one even less, about 6½ kilogrammes. Moreover, the large exterior surface of the apparatus radiating its heat to the air around adapts it admirably for use in heating, as well as for lighting, and it can thus be made to serve the double purpose of giving warmth and light.

M. Sudré has also designed his thermo-pile with a view to obtaining one of small volume and having a low internal resistance; the other peculiarities of his battery consist in the manner in which one set of junctions are heated while the other set are cooled. He has also determined what is the best length for the bars forming the couples, in order that the necessary difference of temperature at the two extremities may be maintained, while yet making them as small as possible. This he finds should be from 10 to 30 millimetres, according to the difference of temperature required. His manner of soldering together the two different metals is also novel and ingenious. In order that contact may be made with the whole surface of the bar, he cuts the plate, forming one metal, into the shape of a comb, twisting the teeth of this comb together, thus retaining a large surface, which yet has only a short length. The bars are fastened on to these twisted parts and the uncut part of the plate is coated with silicate of soda. The couples are formed in a mould in which the plates are fixed, the melted alloy is then run into the mould so that a block is formed of the alloy and the plates, firmly united. These chains or blocks are then placed between two plates, coated on one side with enamel or other electrically insulating substance; several chains may thus be arranged side by side, each chain being both calorically and electrically insulated. The parts of the chain are electrically insulated by the thickness of the plates, but heat can flow across the couples. The chains are next placed between a collector and a diffuser; the collector is ribbed if the source of heat be gas, in order to expose a greater surface. The diffuser is also ribbed for the same reason when the heat is merely allowed to radiate into the air. The whole battery is so arranged that the collectors form the inside of a circle within which the heated air is circulated.

BIOLOGICAL NOTES

THE BLOOD OF THE LOBSTER.—This liquid has been recently examined by M. Fredericq (Belgian Academy's *Bulletin*, No. 4), whose researches on the octopus were recently published. He finds in it as a rule two colouring matters, one blue, an albuminoid, coagulated by alcohol and heat, and apparently identical with the *hæmocyanine* found in the blood of the octopus; the other of rose colour, and soluble in alcohol (not always present). The former loses its blue colour in vacuo, and recovers it when acted on by oxygen, and it contains copper. The blood of the lobster is rose when it is reduced; exposed to oxygen it takes a special tint, blue with reflected light (hæmocyanine), brown with transmitted light (rose matter). It coagulates spontaneously and therefore contains fibrine. The blood of certain Gasteropoda (*Arion*, *Helix*) is also found to contain hæmocyanine, whereas M. Fredericq has not found it in the Lamellibranchiata (*Unio*, *Anodonta*). The general conclusion is reached that in such different groups of invertebrates as cephalopod and gasteropod molluscs, crustacea and annelids, as well as in vertebrates, respiration is effected by means of metalliferous proteic substances (hæmoglobin, hæmocyanine, chlorocruorine) which form in the respiratory organ (branchia, lung) less stable oxygenated combinations. These latter are dissociated in their passage through the tissues. In invertebrates, the two great functions of the blood, respiration and nutrition of tissues, belong both to the plasma, the corpuscles having a quite accessory importance. In the blood of vertebrates there is, in this respect, a division of physiological work; the respiratory function devolves upon the corpuscles, the nutritive function on the plasma.

ANNELIDS OF THE VIRGINIAN COAST.—Mr. H. E. Webster has just published an account of the Annelida Chætopoda which were collected in the summer months of 1874 and 1876 by the zoological expeditions sent out

under the auspices of Union College, Schenectady, N.Y. (in advance of vol. ix. of the *Transactions* of the Albany Institute, pp. 1-72, plates 1-11). The locality was on the eastern shores of Virginia (Northampton); between the mainland and the islands a large area of dark mud is exposed at low water. It is described as abounding in animal life, and yet the number of species of Annelids described is not large, there being only fifty-nine, relegated to forty-nine genera; of these, four of the genera are new, and twenty-seven of the species. The absence of Mediterranean species seems noteworthy, scarcely any of Ehler's species from the Adriatic or Claparède's, from the Bay of Naples, being quoted.

ACID REACTION OF FLOWERS.—It was stated, as the result of observation, by MM. Fremy and Cloëz, that the juices of all red and rose-red flowers showed an acid reaction, whereas the juices of blue flowers were always neutral, or even weakly alkaline. The subject has been studied afresh by Herr Vogel, who examined 100 species, viz., 39 blue, 44 red, 6 violet, 8 yellow, and 3 white flowers. The experiments (described to the Munich Academy) confirm the view that it is not warrantable to attribute the red colouring of flowers to action of acids or acid salts on blue colouring matter, or to attribute the latter to the influence of alkalies on red colouring matter, though doubtless there is a certain relationship between certain red and blue plant colours. It further appears that the opinion that plant juices generally, and even the majority of flower-juices, have an acid reaction, is pretty correct; among 100 flowers there were only twelve which did not react acidly. On the other hand, the rule above referred to is not found to apply universally, for among thirty-eight blue flowers twenty-eight showed a decidedly acid reaction, though the degree of the acidity was less than in red flowers.

FUNCTION OF SOME CONTRACTILE VACUOLES IN INFUSORIA.—An observation recently published by Herr Engelmann, of Utrecht, throws light on the function of the contractile vacuole in some infusoria. Some time ago he found a new infusory animal, closely allied to *Chilodon cucullulus*, and which he calls *Chilodon propellens;* it is marked by its slender form, and by the round shape of its hinder extremity, where is the contractile vesicle. This animal swims with pretty constant, but very slow, velocity in circling paths. Each time the vacuole contracts (which occurs in pretty regular intervals of about half a minute, and very quickly) there is an impulsive acceleration of the forward motion. If the animal be at rest, it makes, at the moment of systole, an impulsive forward movement about a quarter of its length. No simultaneous acceleration of the very sluggish ciliary movement was observed. The forward motion, then, can only be attributed to the backward thrust of liquid expelled from the contractile vacuole. Herewith agrees the fact that the hinder portion of the body shrinks together, in systole, as though to a thin empty sack folded in longitudinal direction, without the least perceptible increase in volume of the forepart of the body; so that the greater part, if not the whole of the liquid contents of the vacuole, must have been ejected behind. The re-expansion of the vacuole takes place very slowly, and it could not be determined whether liquid was directly drawn in from without. Coloured liquids were never observed to enter the vacuole.

PHYSIOLOGICAL ACTION OF COPPER. — For some years past the majority of medical men have no longer considered salts of copper as true poisons, their innocuousness being partly due to the fact that when they are taken in any considerable quantity, they cannot be kept in the stomach, but produce vomiting. It remained to ascertain whether, in animals incapable of vomiting, salts of copper would act as poison. At a recent meeting of the Société de Biologie, M. Gallipe described some experiments on the subject. He had given several rabbits copper with their food. One of these animals received daily, for six months, two grammes of acetate of copper. At the end of this period, the rabbit showed considerable fattening. Its liver weighed 70 grammes, and contained 13 centigrammes of copper. Further, this rabbit was eaten by the experimenters, who were no way incommoded thereby. This is one fact more (says *La Nature*) in favour of the so-called rehabilitation of copper.

LOCALISATION OF ARSENIC IN THE BRAIN.—Experiments have recently been made on guinea pigs by M. De Poncy and Livon (*Comptes Rendus*), with reference to the localisation of arsenic in the brain, when arsenious acid was given in small doses daily with the food. They found that phosphoric acid increased considerably in the urine, and it can only have come (the authors point out) from an elimination by substitution, not from a pathological state of the animal, for in cerebral affections, rather a diminution than an increase of phosphoric acid in the urine has been observed. The arsenic, then, seems to replace the phosphorus of phosphoglyceric acid in lecithine, producing arsenioglyceric acid. The authors are seeking to isolate this new base.

NOTES

PROF. CHRYSTAL of St. Andrews (formerly of Peterhouse, Cambridge) has been appointed to the Chair of Mathematics in Edinburgh University. He was Second Wrangler and Second Smith's Prizeman in 1875, and is already known to science by his experimental researches on Ohm's Law (made in the Cavendish Laboratory) and by the very excellent article "Electricity" in the new edition of the *Encyclopædia Britannica*. Among the eleven candidates for the chair there were four Senior Wranglers. Thus the Chair of Mathematics in St. Andrews is now vacant; and it has just been announced that Prof. Blackburn has requested the University Court of Glasgow to sanction his retirement from the Chair of Mathematics there. As Prof. Fuller of Aberdeen resigned last year only, the whole of the Mathematical Chairs in Scotland have been vacant within one year.

AT the half-yearly general meeting of the Scottish Meteorological Society, held on Monday, July 21, papers were read on "The Cold Weather since November, compared with Periods of Protracted Cold in Scotland from 1764," by Alexander Buchan; on "The Great Plague of London in Relation to Weather," by Dr. Arthur Mitchell; and on "Ground Swells observed in Scotland since 1868," by Alexander Buchan. With reference to the proposal of General Myer to publish maps exhibiting the simultaneous monthly means in meteorology of the whole of the northern hemisphere, intimated in NATURE, vol. xx. p. 275, the Scottish Meteorologists state, in their Report to the meeting, their conviction "that this truly cosmopolitan work, which the United States alone are in a position to undertake, thanks to the enterprise and liberality of their Government, will bring before us, month by month, the general circulation of the earth's atmosphere, and raise at least, if not satisfy, many inquiries lying at the very root of meteorology, and intimately affecting those atmospheric changes which meteorologists hitherto have been recording."

WE have already referred to the valuable "Bibliographical Contributions" issued by the library of Harvard University and edited by Mr. Justin Winsor, the librarian. One of the most scientifically important of these is a list of apparatus available for scientific researches involving accurate measurements, prepared by means of answers to a circular sent out by Professors Wolcott Gibbs, E. C. Pickering, and Trowbridge, of Harvard. This circular speaks of the cost of the apparatus required for exact quantitative determinations in the various branches of

physics, as always having been a serious obstacle to the prosecution of investigations requiring a high degree of precision. It asks, therefore, from the various institutions addressed, a list of such apparatus of this kind as they possess, and which they are willing to place, under certain restrictions, at the disposal of any properly qualified persons for the purpose of investigation. The principal scientific institutions of the State have responded, and the lists they give convey a highly favourable idea of the completeness and high quality of the apparatus of precision with which American laboratories are furnished. Among the institutions thus prepared to place their equipments at the service of science are the United States Coast Survey, the Academy of Arts and Sciences, the various scientific departments of Harvard University, the Stevens Institute of Technology, Massachusetts Institute of Technology, Columbia College, New York, and the Johns Hopkins University, which, though the youngest of these institutions, has an admirably complete scientific equipment. Mr. Winsor is to be congratulated on the wide extension he has given to the significance of the term bibliography, and on the service he is doing science in the United States.

FROM the *Chemical News* we learn that a newly-discovered metal, Norwegium, has been detected and isolated by Dr. Tellef Dahll in a sample of copper-nickel from Kragerö, in Skjærgaarden. The colour of the pure metal is white, with a slight brownish cast. When polished it has a perfectly metallic lustre, but after a time it becomes covered with a thin film of oxide. It can be flattened out in an agate mortar, and in hardness it resembles copper. The melting-point is 350° C., and the specific gravity 9·441. Its equivalent appears to be 145·9. Only one oxide, NgO, has been obtained. With sulphuretted hydrogen it gives a brown sulphide, even in strongly acid hydrochloric solutions, which redissolves in ammonium sulphide. With a slight addition of potassium ferrocyanide it gives a brown, but with larger proportions a green precipitate. The sulphuric solution is turned brown on the addition of zinc, and the metal is deposited in a pulverulent state. The solutions of this metal are blue, but become greenish on dilution.

THE cranium of Descartes is often adduced as an exception to the general rule that a great mind requires a large brain. This statement seems to have rested on no exact measurement, and Dr. Le Bon resolved recently to test its accuracy. The result is that he finds the cubic capacity of Descartes' skull to be 1,700 centimetres, or 150 centimetres above the mean of Parisian crania of the present time. At the same time Dr. Bordier has recently found the average capacity of the skulls of thirty-six guillotined murderers to be 1,547·91 c.c., the largest reaching the high figure of 2,076 c.c.

THE Paris International Exhibition of Sciences applied to Industry will be opened to-day. It is divided into eleven groups. The first group contains prehistoric subjects, anthropology, sociology, and education. The eight following groups are respectively applications of physics, of chemistry, of mechanics, mechanics applied to locomotion, application of the natural sciences, mathematical sciences, the applications of geology, books, and manuscripts. The tenth group will contain (1) The artificial reproduction of a glacier with an interior grotto, which will show the several geological strata containing characteristic fossils. (2) The reproduction on a large scale of a civilised house of the nineteenth century, a hut of savages, and a prehistoric habitation. (3) A map of Europe in the tertiary period executed in relief. (4) A dioramatic view of the actual site of Paris during that period. (5) Another dioramatic view just before the time when man made his first appearance on the earth. Group 11 will be devoted to a retrospective exhibition of objects belonging to art and industry. The most notable innovation will be the creation of a commission of scientific inquiry to obtain information from exhibitors, which will be published with a commentary from the commission. The commission of patronage is composed of MM. Carnot, Dr. Henry Lionville, Henry Martin, Charles Blanc, &c. The works are progressing with great activity, and are lighted by the electric light on the Jablochkoff system, which will illuminate the Exhibition at night.

WE are requested to state that at the Sheffield meeting of the British Association there will be an important exhibition of scientific apparatus and specimens, both in the temporary museum and at one of the *soirées*. Inventors and others who may have objects of interest to exhibit are desired to at once communicate with the local secretaries, Sheffield, as this will be an unusually favourable opportunity for bringing their discoveries before the scientific world.

AT the recent meeting, already referred to by us, of ladies and gentlemen interested in Japanese art, literature, folk-lore, &c., at the rooms of the Royal Asiatic Society, a committee was appointed to consider the best mode of giving effect to that object in communication with the Council of the Royal Asiatic Society. Among the Committee are—Sir Rutherford Alcock, K.C.B., Sir Charles Wentworth Dilke, Bart., M.P., Prof. Robert K. Douglas, Major Gen. A. Lane Fox, F.R.S., E. J. Reed, C.B., M.P., F.R.S., E. B. Tylor, LL.D., F.R.S. At a meeting of this Committee on the 11th inst. it was resolved that for the objects in view a Society should be formed, to be called the "Nipon (Japan) Institute," to consist of members subscribing a sum of 10*s.* per annum, and that the permission of the Council of the Royal Asiatic Society be asked to allow such Society to hold meetings at their rooms, 22, Albemarle Street. It was also resolved that a Committee be appointed to act, with Mr. Pfoundes as Secretary, in the organisation of such Society, and to conduct the necessary correspondence. On this Committee, besides others, are those whose names are given above. It is proposed that the institution shall consist of a Central Institution; a President; Council; General Committee; Councils of Division, *e.g.*, Antiquities, Art, Anthropology, Folk-lore, Geography, History, Language, Literature, &c., and Committees of Sections; a Chief Branch in Tokio, Japan; Branches in Japan, China, India, Australia and other Colonies, United States and other parts of America, Continent of Europe, Provincial Towns of Great Britain, &c.; in Correspondence with Central Institution; Corresponding Members where no branches exist. The Society is to encourage and reply to inquiry; to solicit literary and scientific ladies and gentlemen to suggest subjects for inquiry and collection of material; to arrange lectures, *soirées*, *conversaziones*, exhibitions, social reunions, and parties to view collections, &c.; and otherwise keep alive the public interest in Japanese topics, &c.

THE "Naturforschende Gesellschaft" of Halle will celebrate the 100th anniversary of its foundation on the 30th instant.

THE death, on July 5, is announced of Dr. Reiff, of Tübingen, formerly Professor of Philosophy at the University of that city.

A NEW natural history museum, formerly the private collection of Dr. L. W. Schaufuss, has just been opened to the public at Blasewitz, near Dresden. Dr. Schaufuss has for many years been in close personal relations with the Archduke Ludwig Salvator, of Austria, well known by his scientific writings and travels, and the new museum therefore bears the name of its founder's august friend and patron. Besides numerous natural history objects it also contains others of anthropological and ethnological interest.

A CORRESPONDENT asks if there is any flora of Cape Colony published? and if there is any book which would be useful in the practical study of the Cape flora? In reply we may state that three volumes have been published of Harvey and Sonder's "*Flora Capensis*" (Lovell Reeve). We understand Mr. Dyer

is engaged upon a continuation of it, the fourth volume being now in progress. For a general review of the flora see Harvey's "Genera of South African Plants," edited by Hooker (Reeve); Harvey's "*Thesaurus Capensis*" may sometimes be procured secondhand.

A LARGE number of mammalian bones of the diluvian period have lately been obtained from the bone-cave of Vypustek, Moravia (Prof. K. Th. Liebe, *Proceed.* Imp. Acad. Vienna, May 23, 1879), and sent to the Imperial Museum at Vienna. The comparison of these remains with those from the Thuringian caves is important, especially with those from the cave of Lindenthal near Gera, which led Liebe and Nehring to the interesting conclusion that all this region was an extensive barren steppe, without any forest vegetation, at the beginning of the Second Diluvial Period. In the cave of Vypustek are found—*Lynx vulgaris*, *Felis catus*, *Canis spelæus*, *C. familiaris*, *Vulpes vulgaris*, *V. lagopus*, *Gulo borealis*, *Martes abietinus*, *Fœtorius putorius*, *F. erminea*, *Vesperugo serotinus*, *Arvicola amphibius*, *A*.sp., *Lepus variabilis* (*timidus?*), *Cricetus frumentarius*, *Myoxus glis*, and *Sciurus vulgaris*. Besides these seventeen species, von Hochstetter found remains of *Elephas primigenius*, *Rhinoceros tichorhinus*, *Equus fossilis*, *Bos priscus*, *Cervus tarandus*, *C. elaphus*, *C. capreolus*, *C. euryceros* (?), *Capra ibex*, *Ursus spelæus*, *Felis spelæa*, and *Hyæna spelæa*; the number of species found in the Vypustek Cave being therefore twenty-nine. The evidence proves that this cave was a den of beasts of prey, long tenanted by families of hyenas and bears, and occasionally visited by lions, lynxes, and wolves; while many side galleries, some opening to day, gave shelter to martens, weasels, and other small carnivores. Some few animals may have been carried into the cave after death by streams and floods; but by far the greater part of the remains are those of tenants of the cave, or of their prey brought in for food. The fauna of this cave indeed bears a decidedly sylvestran character; and it may be admitted that its environs were covered with woods, and had a forest climate, at the time when northern and middle Germany had the features and climate of a steppe. Hence too the mountains and hills of South Bohemia and Moravia may be supposed to have been the centre from which forests advanced gradually in every direction over the great Diluvial Steppe of Europe north of the Alpine chain. Further explorations, to be conducted by the Prehistoric Commission of the Imperial Academy of Vienna, may lead to further interesting facts as to the relative depth and succession of the animal remains in this cave.

GREAT damage to agriculture has been done by swarms of grasshoppers in Hungary, in the Szathmar Comitat. An area of some 600 Hungarian "Joch" is entirely devastated. The local authorities have been compelled to apply to Budapest for military assistance, besides availing themselves of that of the inhabitants of numerous villages in the districts affected by the plague.

ON July 1 a monthly serial, entitled *Der Phonograph*, appeared at Vienna, edited by Wilhelm Stockinger, and having for its object the cultivation and propagation of Faulmann's "phonography."

IN this month's number of the *Mineralogical Magazine* is the history of a remarkable gem, called the "Maxwell-Stuart" topaz, which is undoubtedly the largest cut precious stone known. Its weight is 1,475·9 grains, or 368 carats 3·9 grains; specific gravity, 3·5685. It is perfectly white and very brilliant. It was brought from Ceylon many years ago, and has been for a considerable time, in an uncut state, in the possession of Mr. Maxwell-Stuart, a collector of gems, after whom it takes its name. An idea of its size may be formed by stating that the table is 2½ inches in length. It was cut and polished in London, under the supervision of Mr. Bryce-Wright, the present owner, the operations occupying twenty-eight days.

MR. MORRIS, the well-known botanist in Ceylon, whose endeavours to find a remedy for the disastrous coffee-leaf disease we have before referred to, has established the fact that very favourable results may be obtained from the application by hand of a mixture composed of three parts of lime and one of sulphur.

THE officers of the French Balloon Committee tried several ascents last week, in order to determine the visibility of terrestrial objects at various altitudes.

AT a recent meeting of the French Physical Society M. Bouty described the action of heat on metallised thermometers. The contraction produced at the moment of deposit of the metal is entirely compensated by the difference of the dilatations of the glass and the metallic envelope, at a temperature which is higher the greater the contraction, and the smaller the difference of the dilatations, but independent of the thickness of the deposit. Above this critical temperature traction takes the place of pressure on the bulb; ruptures presently occur at the surface of contact, and the result is permanent deformations, which produce a new displacement of zero. This latter effect is never produced when the critical temperature is not exceeded. A metallised thermometer may be used to measure temperatures, if it have been compared with a typical thermometer, from which it does not differ sensibly unless the metallic deposit be of considerable thickness. When sulphate of copper is electrolysed between two very sensitive thermometers, coated with copper superficially, the thermometer attached to the positive pole is found to be at a temperature superior, the negative thermometer at a temperature inferior, to that of the surrounding liquid. The same phenomenon is observed in electrolysing sulphate of zinc between two thermometers covered with zinc. M. Bouty recalled the fact that when two plates of zinc or of copper are kept at different temperatures in the corresponding sulphate, a current arises, and the warmer metal is the positive pole. There is between the production of these currents and the phenomena studied by M. Bouty a relation of reversibility similar to that which connects Peltier's phenomenon and ordinary thermo-electric currents.

THE electro-magnetic rotation of the plane of polarisation of light in gases has recently been proved and studied variously by Kundt and Röntgen, Bichat and H. Becquerel. The last-named observer, by a superior method, measured the phenomenon especially in ordinary coal gas, while the others demonstrated the rotation in sulphide of carbon vapour, gaseous sulphurous acid, and sulphuretted hydrogen. In a paper to the Vienna Academy, Prof. Lippich, of Prague, describes additional experiments on the subject. He aimed especially at perfecting the optical part of the apparatus, and attained remarkable accuracy. He succeeded in demonstrating the rotation *in air*, using a large coil 0·5 metres long, with 365 m. length of copper wire (nearly 3 mm. thick) in twelve layers. The current was from sixty average Bunsen elements, combined in a battery of thirty double elements. The light-ray was simply sent through the hollow part of the coil. Under these circumstances an unmistakable electro-magnetic rotation was observed, and it was in the direction of the current coursing round the air. The angle of rotation could not have been far from 6 to 10 seconds of arc. (An exact determination was not possible, owing to the provisional arrangement of the optical apparatus.)

THE last number of the *Journal* of the Society of Arts contains two elaborate papers by Mr. A. T. Atchison and Mr. W. H. Penning, giving suggestions for dividing England and Wales into watershed districts, with reference to the National Water Supply.

THE *Sanitary Record* is now appearing in an enlarged form as a monthly, instead of a weekly as hitherto.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mr. Robt. F. Clothier; two Ring-tailed Lemurs (*Lemur catta*) from Madagascar, presented by Mr. Hugh McCubbin; a European Bearded Vulture (*Gypaetus barbatus*) from Southern Spain, presented by Lord Lilford, F.Z.S.; three Globose Curassows (*Crax globicera*) from Central America, presented by Major F. Hime; a Lesser Sulphur-crested Cockatoo (*Cacatua tenuirostris*) from Moluccas, presented by Miss Langley; a White-tailed Gnu (*Catoblepas gnu*) from South Africa, two Mule Deer (*Cervus macrotis*) from North America, a Common Ocelot (*Felis pardalis*), a Red and Yellow Macaw (*Ara chloroptera*) from South America, deposited; a Funereal Cockatoo (*Calyptorhynchus funereus*) from New South Wales, four Common Crowned Pigeons (*Goura coronata*) from New Guinea, two Yellow-bellied Parrakeets (*Platycercus flaviventris*) from Tasmania, an American Kestrel (*Tinnunculus sparverius*) from South America, a Smooth Snake (*Coronella lævis*) from Hampshire, purchased.

ON TWO METEORS OBSERVED IN SWEDEN IN 1877[1]

THE first meteor was observed over a great part of the middle of Sweden from Stockholm, in the east, to Charlottenberg (and Christiania), in the west, and from the neighbourhood of Åreskutan, in the north, to Jönköping, in the south. Accounts of the phenomenon by forty-seven different observers are given. By a comparison of a number of those observations it appears that the meteor was seen nearly simultaneously over the whole of the area where it was visible, on March 18, at 7h. 52·5m. P.M. Greenwich mean time. The phenomenon lasted only a few seconds.

When lines, showing the direction in which the meteor was seen from every separate point of observation to sink under the horizon or in which the last explosion took place, are drawn on the map, most of them meet on the Lake Vener, in the region of Vermlands Näs. The terminal point of the meteor's path was thus clearly situated above this region. Observations from Stockholm, that the meteor disappeared about half way between the moon and the horizon, and from Örebro that it split into fragments by the side of the moon, show that the last explosion took place at a height of 37 to 38 kilometres. Observations from Carlstad and Edsvalla, that the meteor passed through the zenith, and from Mora, that its path was vertical, indicate a projection of its path over Mora and Carlstad, to Vermlands Näs. At first its inclination appears to have been only about 30°, but afterwards it became considerably greater. Besides the final explosion there were three other points of the meteor's path at which it threw out sparks, the first at a very considerable height—*over 200 kilometres*, the second at a height of 100 to 150 kilometres. These figures, for which, however, no great degree of accuracy can be claimed, are deduced from an observation made in the neighbourhood of Örebro. That the continuation of the meteor's path could not be observed from this point was probably caused by the masses of dense cloud which the meteor heaped before it in its path, and which, in the neighbourhood of the place where it fell, almost completely concealed it from view.

As is commonly the case with meteor detonations in general, the sound was propagated with excessive irregularity, violent explosions having been heard in some places, while in others close by the whole phenomenon appeared to proceed without sound.

The circumstance that in the region of Vermlands Näs, at Edsvalla, Carlstad, Kinnekulle, and other places over which the meteor sprang asunder for the last time, no proper fireball was visible, but only a thrice-repeated lightning-like flash, shows that here, too, a part of the meteor's light was intercepted by the dense, cloudy masses which the meteor drove before it. A remarkable observation was made at Skinnskatteberg. There the strongly-luminous meteor projected on the snow-covered ground four or five bands of light with dark intervals, "without there being any object between the meteor and the earth to cast a shadow," the shadow in this case having probably been caused by fragments of cloud in the neighbourhood of the meteor.

The diameter of the meteor, as calculated from a number of observations of apparent size, varied from 200 to 2,500 metres. Prof. Nordenskjöld considers it probable that the Vener meteor, in its path through the atmosphere, formed a luminous ball of 400 to 500 metres' diameter.

When the above-described phenomenon took place, the ground in the middle and north of Sweden was still covered with snow, a circumstance favourable for ascertaining whether any solid particles fell from the meteor in question in the form of meteoric dust to the surface of the earth. Prof. Nordenskjöld requested a student, Herr Svenonius, to proceed to the supposed place of fall, and to endeavour, both by his own researches and by inquiries of persons resident in the region, to discover any remains of the meteor. He travelled several times across the region, and employed a large number of people in searching on the ice on Lake Vener. The result was negative, with the exception that Herr Svenonius found on Lake Vener small quantities of a black or dark grey dust, of doubtful origin, which under the microscope appeared to consist of—

1. Small aggregates of cells derived from higher plants and isolated or coupled plant-cells.
2. A black colloid substance, which formed the main mass of the dust.
3. Inorganic particles of dust, which were *isotropical*, and could thereby be easily distinguished from grains of sand, which entered very sparingly into the mixture. The dust scarcely contained any particles that were capable of being attracted by the magnet, whereby it differed completely from the dust collected on the polar ice during the Swedish expedition of 1872-73. From the small quantity of material that could be employed for analysis, no complete chemical examination of the inorganic constituents could be carried out. The principal constituents were silica, 38 per cent., oxide of iron, 34 per cent., alumina, 8 per cent. No trace of cobalt, nickel, or phosphorus could be discovered.

The dust was found in small quantity on the borders of the small pools, which, under the influence of the spring rise of temperature, were formed everywhere on the ice of Lake Vener.

It is probable that this meteor mainly consisted partly of gaseous substances, partly of carbon, so finely divided that it was completely burned during the short path of the meteor in the atmosphere of our globe.

The second meteor was seen on April 29 at 8.37 P.M. Greenwich mean time, over the greater part of Sweden, from a point lying a little to the south-east of Gothenburg to Vittangi in the extreme north. It was also seen over a great part of Finland, and at St. Petersburg and Dorpat. Accounts from no fewer than seventy-three different places are given. The meteor had, when first observed, the appearance of a large star. Its size increased, however, at first slowly, afterwards rapidly, so that it at length gave out a light so bright that the country over which it passed was lighted up as if it had been full day. The light increased in brightness until the meteor exploded about half way between Luleå and Piteå at a height of 35 kilometres. The time that elapsed between the first appearance of the meteor and its explosion did not exceed a minute and a half. The phenomenon, however, did not come to an end then. A part of the meteor appears, after the explosion, to have continued its course, and perhaps may have passed out of the atmosphere. Besides the usual line of sparks which generally marks the path of a meteor for some moments, there occurred in this case along a considerable part of the path a splendid light phenomenon of a red colour, *which, however, was only observed in regions far removed from the place of explosion*. This red appearance lasted from fifteen to thirty minutes. After it ceased the path of the meteor was still marked in the heavens for a long time (upwards of an hour) as a light band of cloud, which first assumed a zigzag form and then gradually disappeared. The whole phenomenon accordingly lasted nearly two hours, and it is probable *that the meteor, or parts of it, both when it first appeared as a star and after the red light ceased, shone not with its own light but with light reflected from the sun*.

The statements as to the time during which the *fire-ball itself* was luminous in the atmosphere differ, varying from some few to ninety seconds. The latter, however, is the only one which has reference to the whole of the time during which the meteor was luminous from its first appearance as a large star to its explosion

[1] By Prof. Nordenskjöld. Abstract of two papers in *Trans.* of the Geological Society of Stockholm, 1878, Nos. 45, 46, and 47.

in the region of Luleå. The red light was visible at different places for periods varying from ten to thirty minutes, the light streak of cloud from some minutes to seventy-five, the whole phenomenon being visible from ten to 105 minutes.

At places nearest to the locality of explosion and at some others there was seen only the intensely luminous fire-ball, not the red after-light, probably in part owing to the sky being cloudy, and in part also for the same reason as that which caused the dark central field in the case of the Ställdalen meteor.

The observations reported correspond so closely with the figures calculated on the supposition that the explosion took place *half way between Luleå and Nederkalix at a height of* 35 *kilometres above the surface of the earth*, that this point of the meteor's path may be considered as determined with considerable accuracy.

All observers agree in this, that the red pillar of fire which immediately after the explosion was seen at Upsala, Stockholm, Fredrikshamn, St. Petersburg, &c., had at first the same direction as the meteor's spark-bestrewn path, but that the position of the fire-pillar towards the close of the phenomenon underwent change by its spreading out to a height in the atmosphere which in the north of the Gulf of Bothnia was about three times as great as that of the fire-ball proper.

The tangent of the meteor's path at the place of fall had an inclination to the horizon of about 25°. The radiation point was situated somewhere in the constellation Orion. The meteor appears to have been first seen at a height at which it was beyond the earth's shadow, and illuminated by the sun. At first it had the appearance of a bright star, but afterwards increased rapidly in diameter till its apparent size was equal to that of the sun or moon. From a comparison of numerous observation it appears that the meteor's luminous nucleus had a diameter of 1,000 metres.

The Luleå meteor is interesting for the splendid light-phenomenon visible after its explosion, and particularly for the long time it remained in the atmosphere without much change of place.

This light began immediately before the meteor exploded in the region of Luleå, but it could not have been caused by combustible substances thrown off in consequence of the explosion, as in that case the red light ought to have spread itself from the place of explosion about equally in all directions, and afterwards have sunk down rapidly and gone out. Instead, this light was extended in the direction of the meteor's path, and it remained in the sky for more than an hour. An approximate idea of its size and height in the atmosphere is given by observations at Upsala and Fredrikshamn:—

	Breadth of the red luminous pillar.	Approximate height of the point.
Upsala (2)	6 kilom.	125 kilom.
Fredrikshamn ...	12 ,,	150 ,,

The appearance of this light varied much. At some places it resembled a pillar of equal breadth ("like a beam"), at others it appeared as a red spot, from which a pillar of the same colour descended to the horizon but disappeared sooner; at others, again, luminous rings were observed. After the light itself disappeared, its position in the sky was marked for a long time by numbers of "wool-like" clouds.

Several observers remark that the red fire-pillar in question, during the time that it remained visible in the sky, slowly assumed a more vertical position, and then took the form of a 7 or a reversed S.

The Luleå meteor besides, like most other meteors, left behind it for some moments a white luminous streak of fire in that part of the sky through which it passed. This streak of fire clearly arose from constituent parts of the fireball proper which had been loosened by the resistance of the air, and remained behind.

The red light, on the other hand, appears to have had a different origin. It could not have consisted of small particles left behind in the uppermost strata of the atmosphere, for they would speedily have fallen down. The light rather appears to have originated from new combustible or luminous material which followed the nucleus of the meteor, and for the space of half an hour entered the atmosphere at nearly the same place. The Luleå meteor was thus a true cometoid.

It appears that the attraction of the earth and the retardation caused by the resistance of the air gave the path of the dust, causing the red light, a more parabolic form than that of the meteor's nucleus, for a number of observers state that the red pillar gradually raised itself from the slanting position of the path of the meteor towards the vertical line. The direction of the meteor's train, as in the case of true comets, did not lie quite in the path of the meteor. The foot of the luminous pillar was observed above Avasaxa at a height of about 100 kilometres when the nucleus exploded north of Luleå. After the disappearance of the red light there remained white and woolly clouds, resembling light clouds illuminated by the sun. These may have arisen from parts of the meteor which were directly illuminated by the sun, and thus became visible when the stronger light, caused by direct combustion, ceased. On April 29, in the latitude of Avasaxa, bodies at a greater height from the surface of the earth than 76 kilometres are beyond the shadow of the earth even at midnight.

The meteor's light was at first white, then for a long time of the same shade of red as the dawn, and near the close of the phenomenon again white. The light probably arose from the combustion of carbon and carburetted hydrogen, the products of combustion, steam, carbonic acid, &c., absorbing part of the rays of light, and giving the nucleus a reddish tinge. Towards the close the gaseous envelope was dispersed, and the red colour ceased a long while before the meteor finally disappeared. Search was made for any meteorites or meteoric dust that might have fallen, but none were found, although stones were seen to fall to the ground "like rain" by two Lapp girls near Jockmock, and a Lapp reindeer-herd on the mountain Sarvikobbo saw the "stone-swarm" in question disappear in the forest *below* him.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 6.—In view of the considerable discrepancy between observation and theory with regard to the propagation of electricity, Herr Lorenz has been led to make fresh experiments (here described). In one method the telephone was used; the other was a modification of Feddersen's jar-discharge method. Herr Lorenz shows that, in the case of iron telegraph lines, the magnetism of the iron must be considered. The electro-dynamic constant of unit length of an overland telegraph wire is expressed by $C = 2 \log. \frac{2h}{a} + 2\pi k$, where h denotes the height above the ground, a the radius of the wire, and k the function of magnetisation. For unmagnetic wires, the latter member falls away. Applying the formula to Fizeau and Gounelle's experiments, and putting the function of magnetisation of the iron wire = 10, we get the velocity 126000 km., while that observed was 101710 km. The difference is much less than by the ordinary reckoning, and may be attributed, the author thinks, to faults of insulation.—Studying the generation of the currents of a Gramme machine with regard to time and resistance, Herr Herwig finds, *inter alia*, that at the commencement a greater manifestation of force is obtained with greater resistances; but in later stages of development of the current, the force increases more for smaller resistances. The slow development of current with great resistances is shown by the fact that with 13·4 Siemens' units, the full force possible was not reached in four seconds.—Prof. Colley concludes from experiment, that the "polarisation of electrodes" in electrolytes is not to be attributed to dielectric polarisation of the latter, but deserves the name just given. It is not denied, however, that the dielectric polarisation may exist, being completely masked by the other.—Herr Settegaast makes some contributions to quantitative spectral analysis; his paper treating (1) of distribution of a base between chromic acid and other acids; (2) of quantitative mode of determination of nitric acid, and (3) of determination of phosphoric acid.—Among the remaining subjects handled, we note the angle of polarisation of fuchsin (Glan), application of the method of dimensions to proof of physical propositions (Neesen), and the heat-conduction of liquids with reference to currents arising from differences of temperature (Oberbeck).

THE *Quarterly Journal of Microscopical Science*, July, contains:—Notes on some of the reticularian rhizopoda of the *Challenger* expedition, by H. B. Brady, F.R.S., with a plate. In this second memoir several new and most interesting forms are described and figured. The author mentions that he has failed to detect in fresh specimens of *Dactylopora eruca*, P. & J., the structures figured by M. Munier-Chalmas, which figures happen to be reproduced in this number of the Journal, as part of the minutes of the Dublin Microscopical Club.—On the morphology of the vertebrate olfactory organ, by A. M. Marshall, M.A., with two plates.—On the brain of *Blatta orientalis*, by E. T. Newton, with two plates.—On the microphytes which have been found in the blood and their relation to disease, by Dr. T. R. Lewis, with

a plate.—Observations on the glandular epithelium and division of nuclei in the skin of the newt, by Dr. Klein, with a plate.—On the early development of the Lacertilia, with observations on the nature and relations of the primitive streak, by F. M. Balfour, M.A., with a plate.—On certain points in the anatomy of *Peripatus capensis*, by F. M. Balfour, M.A.—Notes and Memoranda.—Proceedings of the Dublin Microscopical club from November 21, 1878, to March 20, 1879.

THE *Journal of Anatomy and Physiology, Normal and Pathological*, July, contains:—On supernumerary nipples and mammæ, with an account of 65 instances observed by Dr. J. M. Bruce, with a plate.—On the origin and composition of the bodies found in compound ganglia, by Dr. G. T. Beatson.—On the physiology of the Turkish bath, being an inquiry into the effects of hot dry air upon man, by Dr. W. J. Fleming.—On the form and structure of the teeth of *Mesoplodon layardii* and *M. sowerbyii*, by Prof. Dr. Turner.—On the element of symbolic correlation in expression, by Prof. Dr. Cleland.—On an intra-thoracic lymphoid tumour, by Dr. R. H. Clay.—On inequality in length of the lower limbs, by Dr. J. G. Garson.—On a large subarachnoid cyst involving the greater part of the parietal lobe of the brain, by Dr. D. J. Cunningham.—On the process of healing, by Dr. D. J. Hamilton, with a plate.—On the dentition of *Bettongia penicillatus*, Gray, by George Leslie.—On a new theory of contraction of striated muscle, and demonstration of the composition of the broad dark bands, by Dr. D. Newman, with two plates.—Note of a case of articulation between two ribs, by Dr. J. H. Scott, with a note by Prof. Dr. Turner.—Additional note on the organ of Bojanus, by M. M. Hartog, M.A.—On a two-headed sartorius, by G. S. Brock.—Note on ethidene, by Prof. Dr. M'Kendrick.—Notice of Kölliker's "Developmental History of Men and the Higher Animals," by F. M. Balfour.

Zeitschrift für wissenschaftliche Zoologie, Bd. xxxii. Heft iii., contains:—Studies among the sponges, by Prof. Elias Metschnikoff, of Odessa, containing notes on the development of *Halisarca dujardinii*, on the anatomy of Ascetta, on the history of development in the calcareous sponges, on the inception of nourishment in sponges, and concluding with some general remarks on the group. Four folding plates illustrate this memoir.—On the power possessed by different mammals of holding fast to and moving upwards by means of atmospheric pressure on smooth and more or less perpendicular surfaces, by Dr. O. Mohnike.—Contributions to our knowledge of the organs of generation in the free living copepoda, by Dr. A. Gruber, with five plates.—Researches on the minute structure of the intestinal canal in *Emys europæa*, by Dr. J. Machate, with a plate.—On a new species of infusorian (*Tintinnus semiciliatus*), by Dr. V. Sterki, with figures.—On the final alterations in Meckel's cartilage, by Dr. B. Baumüller, with two plates.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, July 14.—M. Daubrée in the chair.—The following papers were read:—Addition to my memoir on the principle of least action, by M. Serret.—On the direct combination of cyanogen with hydrogen and the metals, by M. Berthelot. Cyanogen and hydrogen, pure and dry, mixed in equal volumes, and sent through a narrow glass tube heated to 500° to 550°, give some sign of combination; but the reaction is more complete when the mixture is heated several hours to the same temperature in a sealed tube of hard glass; this is afterwards opened over mercury. The union of cyanogen with some metals was found also to be merely a question of time and temperature. The substances were heated together in a sealed tube. Silver and mercury did not combine with cyanogen at any temperature. The analogies of cyanogen with the halogen substances are extended in this inquiry, beyond formulæ, to methods of direct synthesis.—On the organo-metallic radicals of tin: stannbutyls and stannamyls, by MM. Cahours and Demarçay.—On an application of the theory of elliptic functions, by M. Picard.—Researches on the effects of the rheostatic machine, by M. Planté. Using a machine of 80 condensers charged by his secondary battery of 800 couples, he obtains noisy sparks more than 0·12 m. long, and if they are produced above an insulating surface sprinkled with flowers of sulphur, they may even attain 0·15 m., and leave a sinuous furrow. When short of their maximum length they often form closed branches like *anastomoses*; also, on the sprinkled surface, *arborescences*, which appear after removing the excess of sulphur by a few light taps. This, M. Planté thinks, may explain the plant-like impressions sometimes found on the bodies of persons struck by lightning. But little dynamic electricity is required for these and other static effects described (that from 3 or 4 Daniell elements). By associating all the condensers in surface, and adding a small special rotating commutator, static effects of *quantity* are had, different from those of *tension*. By mechanical force of successive sparks M. Planté elevates water.—On the treatment by submersion of vines attacked by phylloxera, by M. Faucon. Some of the insects always survive.—On the phylloxera in the Côte d'Or, by M. Viallane.—On the treatment of anthracnose; observations of M. Puel, by M. Portes. The efficacy of lime is demonstrated.—Observations at Marseilles Observatory, by M. Stephan.—On a definite integral, by M. Callandreau.—On the integration of equations with partial derivatives of orders superior to the first, by M. Pellet.—Minimum of dispersion of prisms; achromatism of two lenses of the same substance, by M. Thollon. Two lenses of the same substance, traversed, the one at the minimum of dispersion, the other at the minimum of deviation, by a luminous beam, may at once deflect and achromatise the light. Hence a system of lenses of the same matter may be made, having one focus and at the same time being achromatic.—On the vapour of bisulphydrate of ammonia, by M. Isambert.—On the dissolution of carbonic oxide in acid protochloride of copper, by M. Hammerl. A thermo-chemical investigation.—On the transformation of tartaric acid into glyceric and pyruvic acids, by M. Bouchardat.—On the isomerism of borneol, by M. De Montgolfier.—On bichlorhydrate of turpentine, by the same.—On some derivatives of indigotine, by M. Giraud.—Comparison of effects of inhalations of chloroform and ether, in anæsthetic and in toxical dose, on the heart and the respiration; applications, by M. Arloing. In the first phase attention should be given both to the heart and the respiration, whether chloroform or ether be used; in the second, the heart must be watched, and especially in the case of chloroform; in the third, the respiration. Chloroform should be preferred to ether, where the operation may be long, as the *denouement* of intoxication by ether is more sudden.—Causes of death from intravenous injection of milk and sugar, by MM. Moutard-Martin and Richet. Death from injection of a great quantity of milk is the result of bulbar anæmia, which produces phenomena of excitation.—On the reproduction of Amblystomas at the Museum of Natural History, by M. Vaillant.—Comparative anatomy of the Hirudineæ; organisation of the *Batracobdella latasti*, C. Vig., by M. Vignier.

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